Nov. 4, 1930. F. D. KINNEY 1,780,195

SHEET SEPARATING APPARATUS

Filed Dec. 5, 1928 3 Sheets-Sheet 1

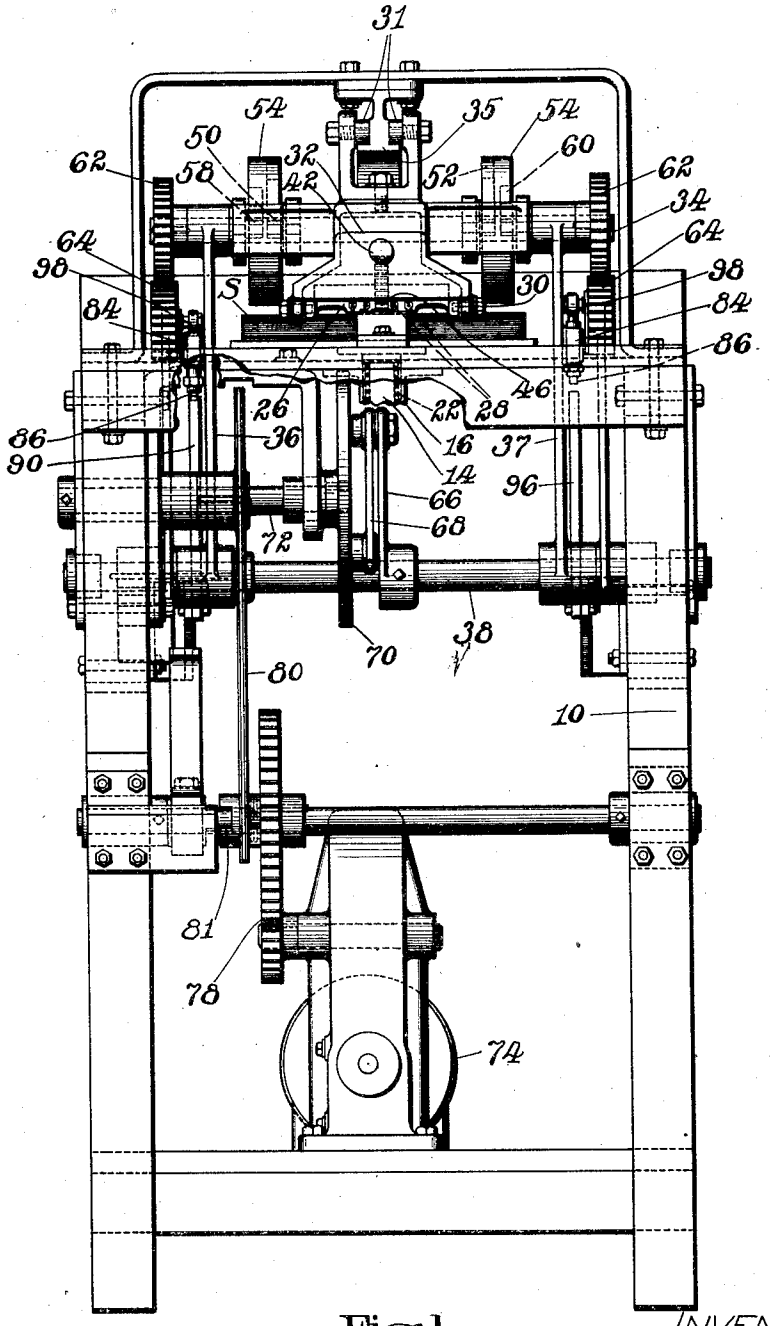


Fig. 1.

INVENTOR.
Fay D. Kinney
By his Attorney,
Harlow M. Davis

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SHEET SEPARATING APPARATUS

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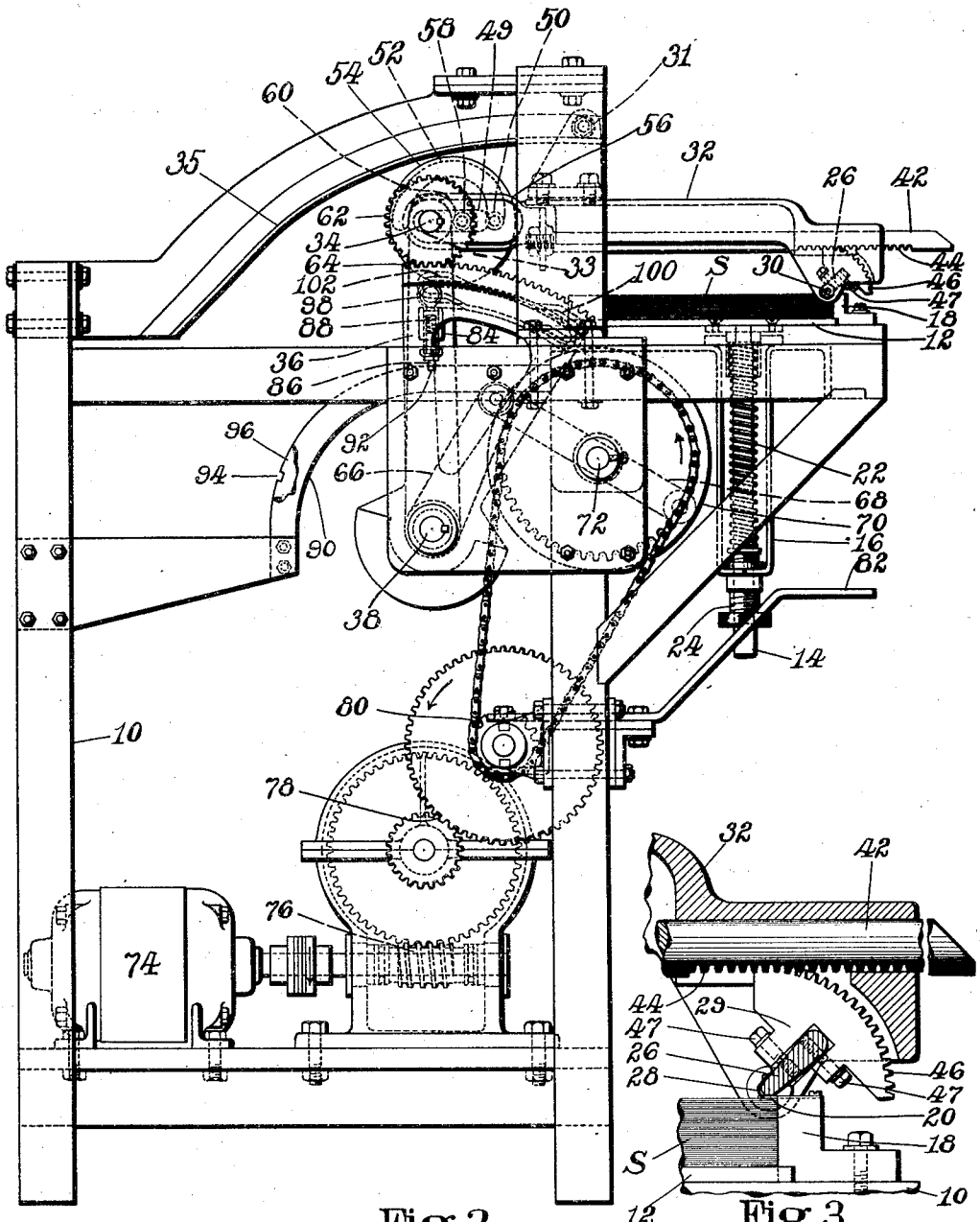


Fig. 2.

Fig. 3.

INVENTOR.

Fay D. Kinney

By his Attorney

Hardow M. Davis

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SHEET SEPARATING APPARATUS

Filed Dec. 5, 1928 3 Sheets-Sheet 3

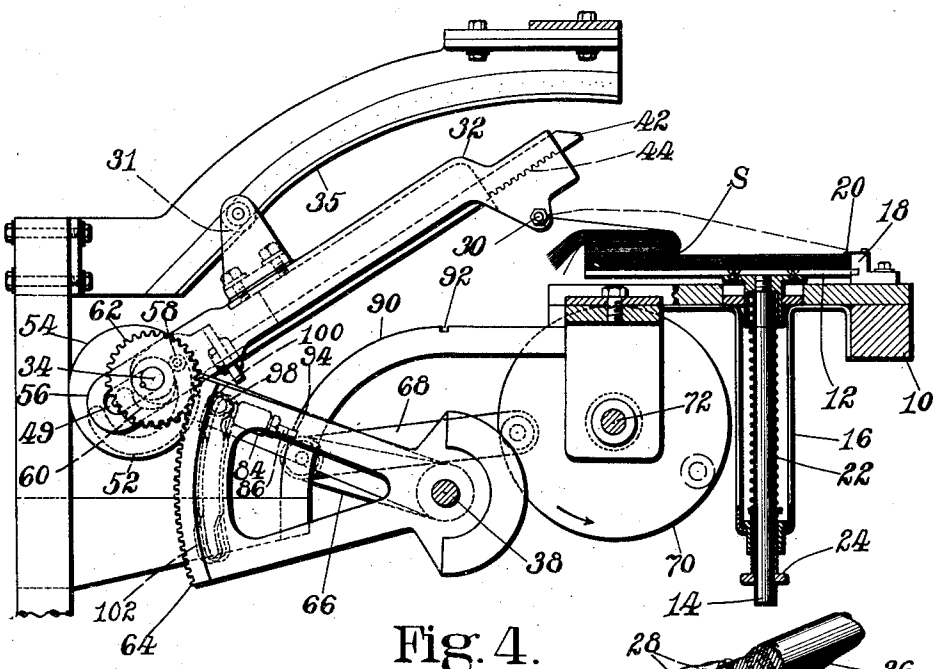


Fig. 4.

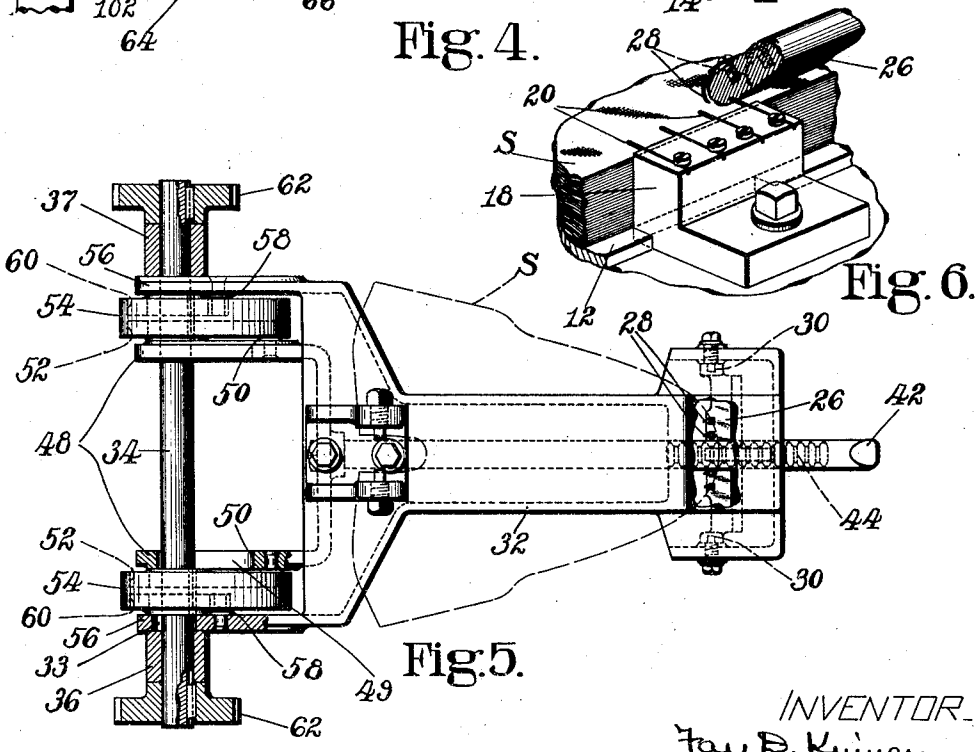


Fig. 6.

Fig. 5.

INVENTOR.
Fay D. Kinney
By his Attorney,
Harlow M. Lewis

Patented Nov. 4, 1930 1,780,195

UNITED STATES PATENT OFFICE

FAY D. KINNEY, OF WENHAM, MASSACHUSETTS, ASSIGNOR TO UNITED SHOE MACHINERY CORPORATION, OF PATERSON, NEW JERSEY, A CORPORATION OF NEW JERSEY

SHEET-SEPARATING APPARATUS

Application filed December 5, 1928. Serial No. 324,028.

My invention relates to apparatus for separating sheets from one another, and particularly to means for successively separating closely adhering sheets from a stack.

Work-pieces, as parts of shoes, are frequently cut with a die from a considerable number of superposed layers of stock, and in certain connections, as in the production of rubber-shoes, the sheets are coated. The pressure of the die forces the cut pieces firmly together, and, with coated stock, they tend to so adhere that they are difficult for the workman performing the succeeding operation to pick apart. An object of this invention is to facilitate such division of stacks or adjacent sheets of material. To this end, I provide a sheet-engaging projection or projections, which may be in the form of needles readily penetrating the stock, together with means for moving the projection and sheets relatively to cause the engagement of a sheet by the projection, preferably near one edge, and means for further moving the projection and sheets relatively to draw the engaged sheet across the succeeding sheet in a direction generally opposite to the engaging movement. The disengaged sheet may be thus laid back over its companions by a separating movement between the projection and engaged sheet without disturbing the associated sheets, which are shown as held against displacement by retaining means. The thus-separated sheet may readily be grasped and removed by the workman. The engaging movement is best effected in two steps, one to initially produce the engagement and the second to perfect such engagement. In the illustrated embodiment of the invention, the projection or projections are moved in a direction substantially parallel to the sheet to be engaged. This, when the projection and stack of sheets are forced together, causes the projection to enter the terminal sheet. Thereupon, revolution of the projection fixes the sheet securely upon it ready for the separating movement. The pressure between the sheet to be engaged and the projection I prefer to obtain by a support for the sheets to be separated, this support being under the influence of means, as a spring, which urges the supported sheets toward the projection. This movement of the work into position for engagement may be limited by an abutment-portion, which also furnishes the retaining means for the body of the stack upon the withdrawal of the engaged sheet. To prevent the projection from entering the sheet succeeding that to be separated, said projection is mounted upon a bar or holder, along a wall of which it extends, being spaced from the wall by a distance substantially equal to the thickness of the material to be separated. Upon engaging movement, as of this holder, the projection effectively penetrates the contacting sheet, but is guarded against entering the next sheet. Since, as already indicated, the movement of the sheet-engaging member is a compound one, the operating cycle being made up of successive work-engaging and separating steps taking place in different directions, and since I prefer to employ actuating mechanism having elements differently controlling one another during the steps, there may be employed, to insure the proper sequence of operation, means for locking an element, as the member through which the engaging projections are actuated, against movement during a portion of the cycle, it being left free to act during another portion. As a result of this, the engagement of the work may be unfailingly completed before the separating travel of the projection starts.

A particular embodiment of this invention appears in the accompanying drawings.

Fig. 1 is a front elevation of my improved separating apparatus;

Fig. 2, a side elevation, looking from the left in Fig. 1;

Fig. 3, a vertical sectional detail, on an enlarged scale, through the sheet-engaging device;

Fig. 4 shows the operating elements more closely associated with the work in side elevation and section, these elements being in the extreme separating position;

Fig. 5 is a top plan view of these operating elements; and

Fig. 6 shows in perspective the work-abutment.

A frame 10 carries at its forward extremity a horizontal work-supporting table 12 which is mounted upon the upper end of a spindle 14. The spindle is guided for vertical movement in the frame and in a depending bracket 16. A vertical abutment or gage 18 furnishes a surface determining, by its contact, the position of a stack of work-pieces S, which may be shoe-vamps, adhering more or less closely to one another because of a coating upon one side of each piece. Projecting horizontally from the top of the abutment, over the stack of work-pieces, is a series of limiting and retaining fingers 20, which are preferably somewhat flexible. The upper piece of the stack is forced constantly against the fingers by a spring 22 acting upon the table 12, it surrounding the spindle 14 and abutting at its lower extremity against a sleeve 24 threaded into the bottom of the bracket 16. By turning the sleeve to raise or lower it, the force exerted by the spring to urge the stack against the fingers 20 may be varied.

Operating above the table is a device for engaging and separating successively from the stack the upper sheets. This device includes a holder furnished by a bar 26 extending transversely of the table and having its lower edge curved upon substantially the arc of a circle. Fixed to one side of the bar, and so curved that they are approximately concentric to the lower edge, is a series of needles or projections 28, sharp at their free ends to facilitate their entrance into the sheets. The space between the projections and the adjacent edge of the bar is practically equal to the thickness of one of the sheets to be separated, this allowing the projections to enter the upper layer of stock without penetrating the succeeding layer. The bar 26 is pivoted at 30 to oscillate upon a supporting arm 32 arranged to turn about a shaft 34 and also to move bodily thereon by virtue of slots 33 in the arm, through which the shaft passes. In its bodily movement, on the shaft and, later in the operating cycle, with said shaft, the arm 32 receives the guidance of a curved T-track 35 mounted upon the frame, and on which run rolls 31 upon the arm. The shaft 34 is rotatable in actuating arms 36 and 37 loose upon an actuating shaft 38 journaled at opposite sides of the frame. To the projections 28 are imparted three distinct movements during a work-engaging and separating cycle. The arm 32 is first moved horizontally to the right (Figs. 2 and 3) to cause the projections to be forced into the upper sheet as this is pressed upwardly by the table 12. Then the projections are revolved in an anti-clockwise direction, to perfect their engagement and lock the material temporarily upon them. Finally, the arm 32 is carried upwardly and rearwardly, as indicated by the dash-line in Fig. 4, to separate the engaged sheet from the body of the stack, it being drawn from under the fingers 20, which retain the remainder of the stack against displacement. The movements of the arm 34 and bar 26 are then reversed, to complete a cycle. An actuating mechanism by which these results may be obtained is as follows: Guided for longitudinal movement in the supporting arm 32 is a slide 42 having rack-teeth 44 meshing with a gear-segment 46 clamped by screws 47 upon the bar 26. On the inner end of the slide is a yoke, in opposite arms 48, 48 (Fig. 5) of which are slots 49, 49 receiving the shaft 34, each arm being provided with a projection 50 entering a cam-groove 52 in the inner face of a disk 54 secured eccentrically upon the shaft 34. The arm 32 is furnished with spaced yoke-portions 56, 56, similar to those of the slide, each of which portions contains one of the slots 33 and has a projection 58 operating in a cam-groove 60 in the inner face of the corresponding disk 54. Fast upon each end of the shaft 34 is a pinion 62 meshing with a gear-segment 64 attached to the shaft 38. Also fixed to the last-mentioned shaft is an arm 66, joined by a link 68 to a pin of a crank-disk 70 upon a shaft 72 rotatable in the frame. The shaft 72 is driven from a motor 74, at a relatively slow speed, through worm-gearing 76, spur-gearing 78 and sprocket-gearing 80, a clutch 81 with a hand-lever 82 being included in the connections to control the operation of the apparatus. At the beginning of a cycle, the elements are as illustrated in Figs. 2 and 3. As the crank-disk 70 turns in the direction of the arrow the cam-disks 54 are rotated in a clockwise direction by the segments 64. The cam-grooves 52 and 60, acting together, simultaneously move the arm 32 and the slide 42 to the right at the same speed for a sufficient distance to force the projections 28 into the upper sheet of material. This sheet is pressed against the projections by the table 12, and the angular position of said projections and the limiting effect of the curved end of the bar allow the engagement of the upper sheet without penetration of the sheet below. Following this, the cam-grooves cause the arm 32 to be held stationary, while the slide 42 travels to the left. This, through the toothed engagement between the slide and segment 46, rotates the bar anti-clockwise about its pivots 30, downwardly, outwardly and upwardly in the direction of their curvature to complete their entrance into the upper sheet, and holding it firmly upon the bar. This brings the projections 50 and 58 into contact with the ends of the cam-grooves 52 and 60. Thereafter, the pinions 62 are locked against rotation, and

the effect of the segments 64 is to carry the arm 32 supporting the engaging and separating device bodily to the left through a path determined by the form of the track 35. This path is close to the top of the stack, except that, toward the termination of the movement, it rises sufficiently to cause the projections 28 to at all times clear the accumulating sheets as they are separated from the stack and laid back loosely upon one another. This completes the active half of the cycle, and during the succeeding portion, the movements are reversed, the projections being first turned back clockwise to their initial position upon the arm 32 to disengage the sheet, and then this arm restored to its horizontal relation, with the projections ready for engagement with the upper sheet of the stack.

It may be desirable to positively lock the arms 36 and 37 against movement until the cam-grooves 52 and 60 have effected the sheet-engaging action of the projections 28. This guards against premature separating travel of the projections before their engagement with the upper sheet has been completed. A definite relation between the phases of the return-movement is also preferably maintained. In the absence of some special provision, the sequence of operations might be disturbed by friction between the elements, as between the slide 42 and its ways in the arm 32, and between the projections 50 and 58 and the corresponding cam-grooves. Each of the arms 36 and 37 has, guided to move longitudinally in a lug 84, a latching plunger 86 forced downwardly by a spring 88. The end of the plunger of the arm 36 is movable along the edge of a quadrant 90 fixed to the frame, and, at the beginning of an operating cycle, lies within a depression 92 near the top of the quadrant. The plunger of arm 37 similarly occupies a depression 94 in a quadrant 96 at the beginning of the second or restoring half of the cycle. At the outer extremity of each plunger is a roll 98 operating in a cam-groove provided in the adjacent gear-segment 64, the groove receiving the plunger of arm 36 being designated by the numeral 100, while a groove 102 is associated with arm 37. Referring to Fig. 2, it will be seen that the grooves are of reverse contour. All but the extreme left-hand portion of 100 and the right-hand portion of 102 act to allow the plungers to be held by their springs against the edges of the quadrants, ready to enter their respective depressions. The end portions just mentioned diverge outwardly from the bodies of the grooves, serving to lift the plungers from the depressions. Starting with the elements as illustrated in Fig. 2, the plunger of the arm 36 engages the depression 92, so that said arm, and consequently the associated arm 37, is locked against rotation until the sheet-engaging action of the projections 28, under the influence of the cam-grooves 52 and 60, has been completed. Then, in the travel of the segments, the diverging portion of the groove 100 reaches its plunger and raises it from the depression 92. During this movement, the roll of the other plunger is traveling idly upon the surface of its quadrant. As the plunger is thus lifted, the projections 50 and 58 reach the ends of their cam-slots, and, finding the arms unlocked, the sheet-separating movement of the arm 32, under the guidance of the track 35, may occur. When the active travel of the engaging and separating device has been completed, the plunger of the arm 37 arrives at the quadrant-depression 94, entering this and again locking the arms, this time against turning in a clockwise direction. As a result of this, the projections 28 are restored by the cam-grooves 52 and 60 to their normal positions upon the arm 32, and then the end of the groove 102 unlocks the arms by removing the projection from the depression 94, allowing the bodily reverse movement of the arm 32 to be effected upon contact between the left-hand ends of the grooves 52 and 60 with the projections 50 and 58. In this half of the cycle, the plunger of arm 36 is moving idly upon its quadrant, until it reaches the depression 92 to lock the parts for the beginning of the succeeding cycle.

To outline briefly the operation of the apparatus, a stack of shoe-vamps or other work-pieces is placed upon the table 12, the spring 22 maintaining the upper sheet in contact with the abutment-fingers 20. The operator may now start the apparatus in action by causing the engagement of the clutch 81. At the beginning of a cycle, the elements occupy the positions illustrated in Fig. 2. As the first step, the sheet-engaging projections 28 are moved to the right, as a result of a movement of translation of the holder-bar 26 produced by a corresponding travel of the supporting arm 32 and the slide 42 under the influence of the cam-grooves 60 and 52, respectively. At this time, a plunger 86 is in engagement with the depression 92 in the associated quadrant, so the actuating arms 36 and 37, which move the arm 32 under the guidance of the track 35, are held stationary. After the projections have entered the upper sheet, the force exerted by the spring 22 upon the table 12 assisting in this, the cam-groove 52 shifts the slide 42 independently of the arm 32, thus rotating the bar 26 upon its pivots and turning the projections upwardly to more positively engage the sheet to be separated. Following this, the ends of the grooves 60 and 52 reach the pins 58 and 50 in the yokes of the arm and slide. This stops the rotation of the disks 54 and pinions 62, and, the plunger 86 being withdrawn by the end portion of the cam-groove 100 in the actuating segment 64, the arms 36 and 37 locked to the segments by the

pinions and disks carry the arm 32 with the bar 26 and the engaging projections bodily to the left, guided by the roll 31 operating upon the track 35. This lifts the engaged end of the sheet, and draws it inwardly from under the fingers 20, rolling it over the remainder of the stack, which is retained by the fingers. This travel of the arm 32 may be to such an extent as to leave a portion of the sheets adhering, as appears in Fig. 4 of the drawings, or may be extended to completely separate the sheets. In either case, their successive disengagement from their companions is made easy for an operator. This completes the active half of a cycle. The beginning of the remaining half, or that of restoration, finds the arms 36 and 37 locked by the plunger 86 within the quadrant-depression 94. While the arms are thus retained, the cam 52 causes a revolution of the projections 28 by a turning of the bar 26 under the influence of the slide 42 in the opposite direction to that which produced the engagement at the beginning of the cycle. The withdrawal of the projections from the separated sheet being completed, the left end of the cam-groove 102, acting upon this plunger, unlocks the actuating arms, and there follows complete return of the supporting arm 32 with the slide 42, the bar 26 and the needles 28 to their initial positions.

While I generally prefer to employ engaging means which penetrates the sheets to be separated, it is to be understood that a device of this character is not, in all connections, essential to the satisfactory operation of this invention.

Having described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:—

1. In an apparatus for separating successive sheets, a sheet-engaging projection, means for moving the projection and sheets relatively to cause the engagement of a sheet by the projection, and means for moving the projection and sheets relatively to draw the engaged sheet across the succeeding sheet in a direction generally opposite to the engaging movement.

2. In an apparatus for separating sheets from a stack, a sheet-engaging projection, means for moving the projection and sheets relatively to cause engagement of a sheet near one edge by said projection, and means for moving the projection and sheets relatively to draw the engaged edge of the sheet across the top of the stack toward the opposite edge.

3. In an apparatus for for separating sheets from a stack, a sheet-engaging projection, means for moving the projection and sheets relatively to cause engagement of a sheet near one edge by said projection, means for moving the projection to draw the engaged edge of the sheet across the top of the stack toward the opposite edge, and means for retaining the remainder of the stack against displacement.

4. In an apparatus for separating sheets from a stack, a sheet-engaging projection, means for moving the projection in a plurality of directions to cause engagement of a sheet near one edge by the projection, and means for moving the projection to draw the engaged edge of the sheet across the top of the stack toward the opposite edge.

5. In a sheet-separating apparatus, a curved sheet-engaging projection, means for moving the projection and sheets relatively to cause the engagement of said sheets by the projection, and means for producing a further relative movement in the direction of curvature of the projection to perfect such engagement.

6. In a sheet-separating apparatus, a sheet-engaging projection, means for moving the projection and sheets relatively to cause the engagement of the top sheet of a stack by the projection, means for producing a further relative movement to perfect such engagement, and means for moving the stack and projection relatively to separate the engaged sheet from the stack.

7. In a sheet-separating apparatus, a sheet-engaging projection, means for moving the projection in a direction substantially parallel to the sheet, and means for revolving the projection.

8. In a sheet-separating apparatus, a sheet-engaging projection, means for moving the projection in a direction substantially parallel to the sheet to produce engagement thereof, means for turning the projection in the sheet, and means for moving the projection in engagement with the sheet in a direction generally opposite to that first mentioned.

9. In a sheet-separating apparatus, a sheet-engaging projection, means for moving the projection to cause the engagement near one edge of the top sheet of a stack, and means for moving the projection with the engaged sheet toward the opposite edge of the stack.

10. In a sheet-separating apparatus, a movable support, projections carried by the support, means for moving the support in opposite directions, and means for moving the support in approximately the same directions as just specified but for a different distance.

11. In an apparatus for separating the sheets of a stack, a movable support, projections carried by the support, means for moving the support in opposite directions to cause engagement and disengagement between the projections and the top sheet of the stack, and means for moving the support in opposite directions for a greater distance than that just mentioned for separating the sheet from the stack.

12. In a sheet-separating apparatus, a movable support, projections carried by the support, means for moving the support in oppo-

site directions, means for moving the projections upon the support, and means for moving the support in approximately the first-mentioned directions but for a different distance.

13. In a sheet-separating apparatus, a pivoted actuating member, a supporting member movable by the actuating member, sheet-engaging means upon the supporting member, means for moving the actuating member about its pivot, and means for moving the supporting member independently of the actuating member.

14. In a sheet-separating apparatus, a pivoted actuating member, a supporting member movable by the actuating member, sheet-engaging means upon the supporting member, means for moving the actuating member about its pivot, means for moving the supporting member independently of the actuating member, and means for moving the projections upon the supporting member.

15. In a sheet-separating apparatus, a pivoted actuating member, a supporting member movable by the actuating member, a holder pivoted upon the supporting member and provided with projections, means for moving the actuating member about its pivot, means for moving the supporting member independently of the actuating member, and means for moving the holder upon its pivots.

16. In a sheet-separating apparatus, a pivoted actuating member, a supporting member movable by the actuating member, sheet-engaging means upon the supporting member, means for moving the actuating member about its pivot, and a guide for the supporting member during its movement with the actuating member.

17. In a sheet-separating apparatus, a pivoted actuating arm, means for oscillating the actuating arm, a shaft carried by the actuating arm, a supporting arm under the influence of the shaft, and sheet-engaging means carried by the supporting arm.

18. In a sheet-separating apparatus, a pivoted actuating arm, means for oscillating the actuating arm, a shaft carried by the actuating arm, a supporting arm movable bodily upon the shaft, means for imparting such bodily movement to the supporting arm, means for connecting the supporting arm to move with the shaft and actuating arm, and sheet-engaging means carried by the supporting arm.

19. In a sheet-separating apparatus, a pivoted actuating arm, means for oscillating the actuating arm, a shaft rotatable in the actuating arm, gearing arranged to rotate the shaft, a supporting arm movable bodily upon the shaft, sheet-engaging means carried by the supporting arm, and a cam fixed to the shaft and co-operating with the supporting arm.

20. In a sheet-separating apparatus, a pivoted actuating arm, means for oscillating the actuating arm, a shaft carried by the actuating arm, a supporting arm under the influence of the shaft, a bar mounted to oscillate upon the supporting arm, sheet-engaging means upon the bar, a slide movable upon the supporting arm and connected to the bar, and connections to the shaft for reciprocating the slide.

21. In a sheet-separating apparatus, a pivoted actuating arm, means for oscillating the actuating arm, a shaft carried by the actuating arm, a supporting arm movable bodily upon the shaft, means for imparting such bodily movement to the supporting arm, a slide movable upon the supporting arm, connections for moving the slide from the shaft, means for connecting the supporting arm to move with the shaft and actuating arm, and a bar provided with material-engaging projections pivoted upon the supporting arm.

22. In a sheet-separating apparatus, a pivoted actuating arm, means for oscillating the actuating arm, a shaft carried by the actuating arm, a supporting arm movable bodily upon the shaft, a slide movable upon the supporting arm, cams fixed to the shaft and arranged to impart a bodily movement to the supporting arm and to move the slide upon said arm, means for connecting the supporting arm to move with the shaft and actuating arm, and a bar provided with sheet-engaging projections pivoted upon the supporting arm.

23. In a sheet-separating apparatus, an actuating shaft, means for oscillating the shaft, an actuating arm loose upon the shaft, a gear-segment fixed to the shaft, a shaft rotatable in the actuating arm, a pinion fixed to the arm-shaft and meshing with the segment, a supporting arm movable upon the arm-shaft, sheet-engaging means carried by the supporting arm, and a cam secured to the arm-shaft and acting upon the supporting arm.

24. In a sheet-separating apparatus, an actuating shaft, means for oscillating the shaft, an actuating arm loose upon the shaft, a gear-segment fixed to the shaft, a shaft rotatable in the actuating arm, a pinion fixed to the arm-shaft and meshing with the segment, a supporting arm movable upon the arm-shaft, sheet-engaging projections carried by the supporting arm, and a cam secured to the cam-shaft and acting upon the supporting arm, said cam being arranged to lock the pinion against rotation by the segment.

25. In a sheet-separating apparatus, an actuating shaft, means for oscillating the shaft, an actuating arm loose upon the shaft, a gear segment fixed to the shaft, a shaft rotatable in the actuating arm, a pinion fixed to the arm-shaft and meshing with the segment, a supporting arm bodily movable upon the arm-shaft, a bar pivoted upon the sup-

porting arm, needles carried by the bar, a slide movable upon the supporting arm and connected to the bar, and a cam secured to the arm-shaft and acting upon the supporting arm and slide.

26. In a sheet-separating apparatus, an actuating shaft, means for oscillating the shaft, an actuating arm loose upon the shaft, a gear-segment fixed to the shaft, a shaft rotatable in the actuating arm, a pinion fixed to the arm-shaft and meshing with the segment, a supporting arm bodily movable upon the arm-shaft, a bar pivoted upon the supporting arm, needles carried by the bar, a slide movable upon the supporting arm and connected to the bar, and a cam secured to the arm-shaft and acting upon the supporting arm and slide, the cam having means for limiting the movement of the slide and the bodily movement of the supporting arm upon the shaft and for locking the pinion against rotation by the segment.

27. In a sheet-separating apparatus, a sheet-engaging member, actuating elements for moving the member in different directions during an operating cycle, and means for locking an actuating element against movement during a portion of the cycle.

28. In a sheet-separating apparatus, a sheet-engaging projection, means for moving the projection to enter the sheet and then for separating the thus-entered sheet, and means for preventing the separating movement of the projection until the entering movement has been completed.

29. In a sheet-separating apparatus, a sheet-engaging projection, means for moving the projection and sheets relatively to cause the engagement of the top sheet of a stack by the projection, means for producing a further relative movement to perfect such engagement, means for moving the stack and projection relatively to separate the engaged sheet from the stack, and means for preventing the separating movement of the projection until after the engaging movement.

30. In a sheet-separating apparatus, a pivoted actuating member, a supporting member movable by the actuating member, sheet-engaging means upon the supporting member, means for moving the actuating member about its pivot, means for moving the supporting member independently of the actuating member, and means for locking the actuating member during such independent movement.

31. In a sheet-separating apparatus, a pivoted actuating arm, means for oscillating the actuating arm, means for locking the actuating arm against oscillation, a shaft carried by the actuating arm, a supporting arm under the influence of the shaft, and sheet-engaging means carried by the supporting arm.

32. In a sheet-separating apparatus, a pivoted actuating arm, means for oscillating the actuating arm, a shaft carried by the actuating arm, a supporting arm movable upon the shaft, a lock for the actuating arm effective during such movement, means for connecting the supporting arm to move with the shaft and actuating arm, and sheet-engaging means carried by the supporting arm.

33. In a sheet-separating apparatus, a pivoted actuating arm, means for oscillating the actuating arm, a shaft carried by the actuating arm, a supporting arm under the influence of the shaft, a bar mounted to oscillate upon the supporting arm, sheet-engaging projections upon the bar, a slide movable upon the supporting arm and connected to the bar, connections to the shaft for reciprocating the slide, and a lock for the actuating arm effective during the reciprocation of the slide.

34. In a sheet-separating apparatus, an actuating shaft, means for oscillating the shaft, an actuating arm loose upon the shaft, a plunger arranged to lock the actuating arm against movement, a gear-segment fixed to the shaft, a cam carried by the segment and acting upon the plunger, a shaft rotatable in the actuating arm, a pinion fixed to the arm-shaft and meshing with the segment, a supporting arm movable upon the arm-shaft, sheet-engaging projections carried by the supporting arm, and a cam secured to the arm-shaft and acting upon the supporting arm.

35. In a sheet-separating apparatus, a sheet-support, a projection arranged to enter a sheet upon the support, and means for moving the support to force the sheet into engagement with the projection.

36. In a sheet-separating apparatus, a sheet-support, a projection movable to enter a sheet upon the support, means for moving the support to force the sheet into engagement with the projection, and means co-operating with the projection for limiting the engaging movement of the sheet.

37. In a sheet-separating apparatus, a support for a stack of sheets, an abutment adjacent to and having a portion extending over the stack, means for forcing the terminal sheet of the stack against the extending portion, and a projection movable toward the abutment to engage the terminal sheet and away from the extending portion to free the sheet therefrom.

38. In a sheet-separating apparatus, a movable sheet-engaging projection, a stack-supporting table situated below the path of movement of the projection, and a spring arranged to force the stack upon the table into co-operation with the projection.

39. In a sheet-separating apparatus, a movable sheet-engaging projection, a stack-supporting table situated below the path of movement of the projection, a spring ar-

ranged to force the stack upon the table into co-operation with the projection, and means contacting with the stack for limiting its movement by the table.

40. In a sheet-separating apparatus, a movable sheet-engaging projection, a stack-supporting table situated below the path of movement of the projection, a spring arranged to force the stack upon the table into co-operation with the projection, and an abutment situated at one edge of the table and having a portion extending over the stack.

41. In an apparatus for separating sheets, a holder, and a sheet-engaging projection mounted upon the holder and extending along and being spaced from a wall thereof by a distance substantially equal to the thickness of a sheet of material to be separated.

42. In an apparatus for separating sheets, a holder a sheet-engaging projection mounted upon the holder and extending along and being spaced from a wall thereof by a distance substantially equal to the thickness of a sheet of material to be separated, means for forcing the projection and sheet to be separated into contact, and means for moving the projection and sheet relatively to effect the engagement of the latter.

43. In an apparatus for separating sheets, an oscillatory member having a curved edge, and sheet-engaging needles extending substantially concentric to the curved edge.

44. In an apparatus for separating sheets, an oscillatory member having a curved edge, and sheet-engaging needles extending substantially concentric to the curved edge, the distance between the curved surface of the member and the adjacent sides of the needles being substantially equal to the thickness of a sheet of material to be separated.

45. In an apparatus for separating sheets, an oscillatory bar having a curved edge, sheet-engaging needles extending substantially concentric to the curved edge, the distance between the curved surface of the bar and the adjacent sides of the needles being substantially equal to the thickness of a sheet of material to be separated, means for forcing the sheet to be engaged against the needles, means for moving the bar bodily and thereby causing the needles to engage the sheet, and means for oscillating the bar to complete such engagement.

In testimony whereof I have signed my name to this specification.

FAY D. KINNEY.