

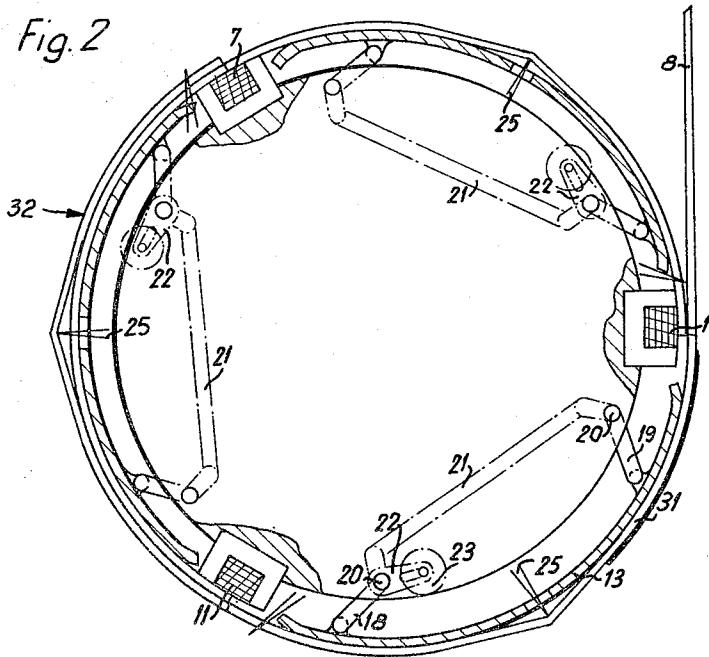
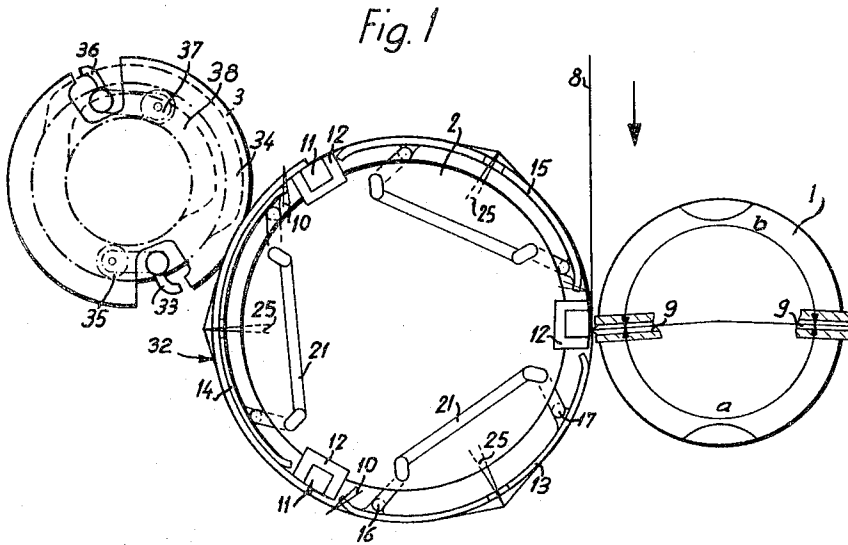
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FOLDING KNIFE- AND BUNDLING CYLINDER  
FOR SHEET FOLDING APPARATUS

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Filed May 22, 1964

2 Sheets-Sheet 1



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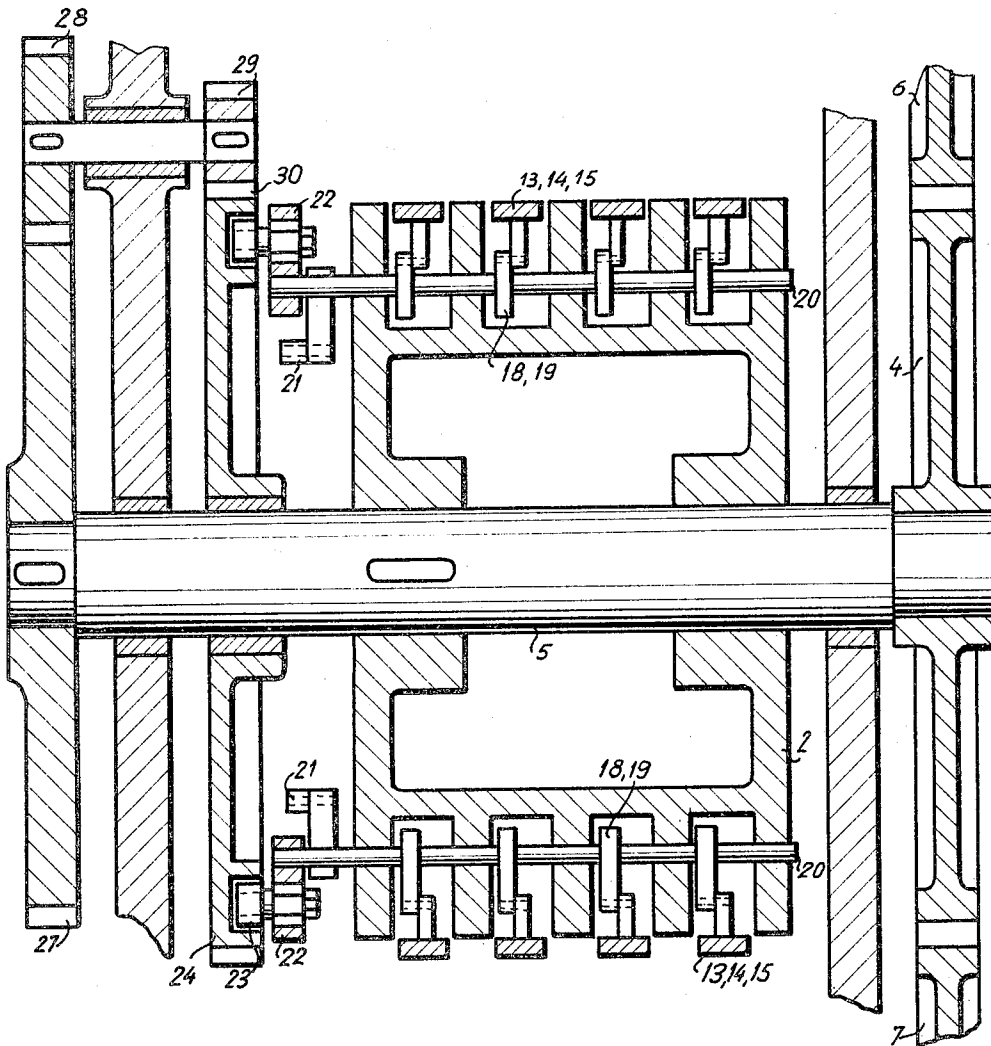
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Fig. 3



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**FOLDING KNIFE- AND BUNDLING CYLINDER FOR SHEET FOLDING APPARATUS**

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6 Claims. (Cl. 270—50)

This invention relates to apparatus for folding and bundling sheets and, more particularly, to a novel, improved folding knife- and bundling cylinder for such apparatus.

In the art of folding and bundling sheets using a folding knife- and bundling cylinder, it is known that the operation of folding is disadvantageously influenced if the peripheral support surface of the folding knife- and bundling cylinder has a constant radius during each revolution. This is due to the fact that the tension of the sheet material, such as paper, will be varied periodically depending upon whether the uncut web is engaged directly with the bare support surface of the cylinder or whether the uncut web is engaged with a stack of sheets of a certain thickness already supported on the cylinder.

Many attempts have been made to design folding knife- and bundling cylinders to overcome this disadvantage. In one of these arrangements, for example, the effective diameter of the folding knife- and bundling cylinder is adjusted by means of interchangeable tongues positioned on the periphery of the cylinder. In another known arrangement, there is an adjusting device for the cylinder diameter, which is actuated when the machine is at a standstill and which is adjusted from run to run, depending upon the number of sheets in a stack. However, the adjusted value of the cylinder diameter remains fixed during operation of the cylinder.

Known arrangements fulfill their purpose only so long as the folding knife cylinder is stationary. However, in operation there is the disadvantage that, when the paper engages directly with the bare peripheral surface of the cylinder, the paper tension is somewhat too low, while, one sheet layer later, the paper tension is too high because the web of paper is then being wound about a radius which has been increased by the thickness of the sheet or sheets already on the cylinder. Since the stacks of sheets usually include a large number of sheets, which is the primary purpose of bundling, the known arrangements are thus insufficient to prevent wide variations in the tension of the paper web.

An object of the invention is to provide a novel improved folding knife- and bundling cylinder for apparatus for folding and bundling sheets.

Another object of the invention is to provide a folding knife- and bundling cylinder including radially displaceable stack support means positioned circumferentially around its periphery and each supporting a respective stack of sheets.

A further object of the invention is to provide a folding knife- and bundling cylinder including means operatively connected with the cylinder and with the stack supporting means and operable, during each revolution of the cylinder, to reciprocate the support means radially of the cylinder between positions corresponding respectively to the minimum and maximum radii of the associated stack of sheets supported thereby.

Still another object of the invention is to provide a folding knife- and bundling cylinder whose periphery is divided into separate segments each supporting a respec-

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tive stack of sheets and each being radially adjustable in accordance with the thickness of the stack of sheets added thereon.

Yet another object of the invention is to provide a folding knife- and bundling cylinder in which segments are apertured for the passage of folding knives there-through.

These and other objects, advantages and novel features of the invention will be apparent from the following description of a typical embodiment of the invention as illustrated in the accompanying drawings.

In the drawings:

FIG. 1 is an end elevation view of sheet folding and bundling apparatus embodying the invention;

FIG. 2 is an enlarged diametrical sectional view of a folding knife- and bundling cylinder embodying the invention; and

FIG. 3 is an axial sectional view through the folding knife- and bundling cylinder shown in FIG. 2.

Referring to FIG. 1 of the drawings, the essential parts of the sheet folding apparatus comprise a knife cylinder 1, a folding knife- and bundling cylinder 2, and a folding flap cylinder 3. These three cylinders are drivingly interconnected by means of a gear 4 fixed to the shaft 5 of the folding knife- and bundling cylinder 2 and meshing with a gear 6 driving the knife cylinder and a gear 7 driving the folding flap cylinder, these gears and the shaft 5 being shown in FIG. 3. In FIG. 1, the paper web 8 on cylinder 2 consisting of separate sheets, is increased in thickness to illustrate the effect of the invention.

The web 8 is cut by a cutting knife 9, of which two are shown in association with the knife cylinder 1, and the cut sheets have their front ends punctured by needles 10 on cylinder 2 and are thus connected to cylinder 2 to be drawn around the periphery thereof. The knives 9 are not in exact diametrical opposition, as the arc *a* has a somewhat less angular extent than that of the arc *b* so that the stack of bundled sheets is cut somewhat shorter. Cutting knives 9 operate against a block 11 of rubber or other resilient material positioned in a mount 12 fixed to the folding knife- and bundling cylinder 2.

The individual stacks of sheets are supported on bearing segments 13, 14 and 15 positioned circumferentially around the periphery of cylinder 2, and each segment has a pair of pivot ears 16 and 17. Levers 18 and 19 have their free ends pivotally connected to the ears 16 and 17, respectively, and are pivoted on pins or the like 20 rotatably mounted in cylinder 2. The levers 18 and 19 are interconnected by a cross tie or link 21. One shaft 20 of each pair has fixed thereto an arm 22 which is longitudinally slotted to receive the axle of a guide roller 23 so that the guide roller is adjustable along the slot. The guide rollers 23 are operatively engaged with a cam groove in a cam wheel 24. When guide rollers 23 move along the groove in cam wheel 24, levers 18 and 19 are oscillated so that bearing segments 13, 14 and 15 are radially reciprocated toward and away from folding knife- and bundling cylinder 2.

Support or bearing segments 13, 14 and 15 are preferably arcuate plates formed with apertures for the passage of the folding knives 25. Alternatively, the arcuate plates may be divided, in an axial direction, into individual strips. Furthermore, instead of there being a single bearing segment for each stack of sheets, several segments can be provided to support each sheet, each segment being provided with corresponding oscillating levers 18 and 19 as well as tie links 21.

Cam wheel 24 is coaxial with cylinder 2 but rotates at an angular velocity different from that of the cylinder 2. Wheel 24 is rotatable upon a bearing 26 on shaft 5, but is drivingly connected with a folding knife- and bundling cylinder 2 through the gears 27, 28 and 29, of which gear 29 meshes with external teeth on cam wheel 24.

The stack of bundled sheets 31 first bears directly on the outer surface of bearing segment 13. During this period, bearing segment 13 is displaced radially outwardly from folding knife- and bundling cylinder 2, through the action of guide rollers 23, so that the outer surface of bearing segment 13 has approximately the velocity of the web 8. In that portion of the cycle represented by the stack of sheets 32, the respective bearing segment is displaced radially inwardly toward the folding knife- and bundling cylinder 2 so that it is no longer the external surface of segment 15, but rather the external surface of the stack of sheets resting thereon, which has substantially the velocity of the paper web. In such a position, bearing segment 15 is capable of receiving, during the following revolution of cylinder 2, a second stack of sheets of a bundled product without increasing the paper tension and without tearing the holes punctured by the needles 10.

In that portion of the cycle represented by the position of bearing segment 14 in FIG. 1, there are illustrated two stacks of sheets which are superposed shortly before the folding process.

Folding flap cylinder 3 has two folding flaps, one of which, for example, the flap 33, is controlled by a cam 34 engaged by a roller 35. For bundling products where only every second or every other stack of sheets is supplied to the folding flap cylinder 3, the folding flap 36 remains open at all times. It is held in this position by roller 37 engaging in the annular cam track 38.

By adjusting the axle of guide rollers 23 along the slots of arms 22, the radial displacement of the bearing segments can be adapted exactly to the thicknesses of the stacked sheets.

#### *Description of operation*

The paper web 8 is led, as shown by the arrow, between the cylinders 1 and 2. Its leading edge is kept by one of the needles 10. Observing the sheet to be accumulated and cut a little shorter, it shows that it lays on the bearing segment 13, the latter being drawn as if unwedged outwards, regulated through cam wheel 24 and guide roller 23. The cylinder 1 driving further, it reaches the position at which the bearing segment 15 stands on the drawing.

Driven through cam wheel 24 the guide roller 23 has taken the position of arm 22 as shown on the drawing.

The roller is then more distant from the center of the cylinder 2 whereas the bearing segment 13 is unwedged inwards through arm 22 and lever 18 nearer to the center of the cylinder 2. This displacement causes that the distance of the outer surface of the bundled sheets 31 results to be the same distance as the external surface of segment 13 formerly had. The paper web 8, joining the accumulated sheet 31 as second part, meets the same circumferential speed as before when the sheet joined directly the bearing segment. At the moment when both parts meet one over the other on cylinder 2 they are overtaken by cylinder 3 in the way known.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. Apparatus for folding and bundling sheets comprising, in combination, a rotatably mounted folding knife- and bundling cylinder; means for feeding sheets to said

cylinder for stacking and folding thereon; plural radially displaceable stack support means positioned circumferentially around the periphery of said cylinder and each supporting a respective stack of sheets; and means operatively connected with said cylinder and said support means and operable, during each revolution of said cylinder, to reciprocate said support means radially of said cylinder between positions corresponding respectively to the minimum and maximum radii of the associated stack of sheets supported thereby; said last-named means comprising a cam and cam followers engaged with said cam and each connected to a respective one of said stack support means.

2. Apparatus for folding and bundling sheets comprising, in combination, a rotatably mounted folding knife- and bundling cylinder; means for feeding sheets to said cylinder for stacking and folding thereon; plural radially displaceable stack support means positioned circumferentially around the periphery of said cylinder and each supporting a respective stack of sheets; and means operatively connected with said cylinder and said support means and operable, during each revolution of said cylinder, to reciprocate said support means radially of said cylinder between positions corresponding respectively to the minimum and maximum radii of the associated stack of sheets supported thereby; said last-named means comprising a cam wheel coaxial with said cylinder and rotatable at an angular velocity coordinated with the angular velocity of said cylinder, said cam wheel being formed with a cam track; and cam followers engaged with said cam track and each connected to a respective one of said stack support means.

3. Apparatus for folding and bundling sheets, as claimed in claim 2, in which each cam follower includes an arm pivoted on said cylinder and carrying a roller engaged in said cam track.

4. Apparatus for folding and bundling sheets comprising, in combination, a rotatably mounted folding knife- and bundling cylinder; means for feeding sheets to said cylinder for stacking and folding thereon; plural radially displaceable stack support means positioned circumferentially around the periphery of said cylinder and each supporting a respective stack of sheets; and means operatively connected with said cylinder and said support means and operable, during each revolution of said cylinder, to reciprocate said support means radially of said cylinder between positions corresponding respectively to the minimum and maximum radii of the associated stack of sheets supported thereby; said stack support means comprising arcuate bearing segments disposed about the periphery of said cylinder; each arcuate segment being pivotally connected to a pair of links each pivoted to said folding knife- and bundling cylinder; said last-named means comprising a cam and cam followers engaged with said cam, each cam follower being connected to a respective pair of said links.

5. Apparatus for folding and bundling sheets comprising, in combination, a rotatably mounted folding knife- and bundling cylinder; means for feeding sheets to said cylinder for stacking and folding thereon; plural radially displaceable stack support means positioned circumferentially around the periphery of said cylinder and each supporting a respective stack of sheets; and means operatively connected with said cylinder and said support means and operable, during each revolution of said cylinder, to reciprocate said support means radially of said cylinder between positions corresponding respectively to the minimum and maximum radii of the associated stack of sheets supported thereby; said stack support means comprising arcuate segments; each arcuate segment being connected, at spaced points therealong, to a pair of links pivoted to said cylinder; means interconnecting said links; a cam wheel coaxial with said cylinder and rotatable at an angular velocity coordinated with the angular velocity of said cylinder, said cam wheel being formed with a cam track; and an arm connected to one link of each pair for

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oscillation therewith and having a roller on its free end engaged with said cam track.

6. Apparatus for folding and bundling sheets, as claimed in claim 5, in which said arm is longitudinally slotted to receive an axle for the associated roller; said axle being adjustable longitudinally of said slot to pre-select the amplitude of reciprocation of the associated stack support means.

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