

Oct. 7, 1969

J. MARCOVITCH
PROFILING OF WORKPIECES

3,470,775

Filed Dec. 27, 1966

6 Sheets-Sheet 1

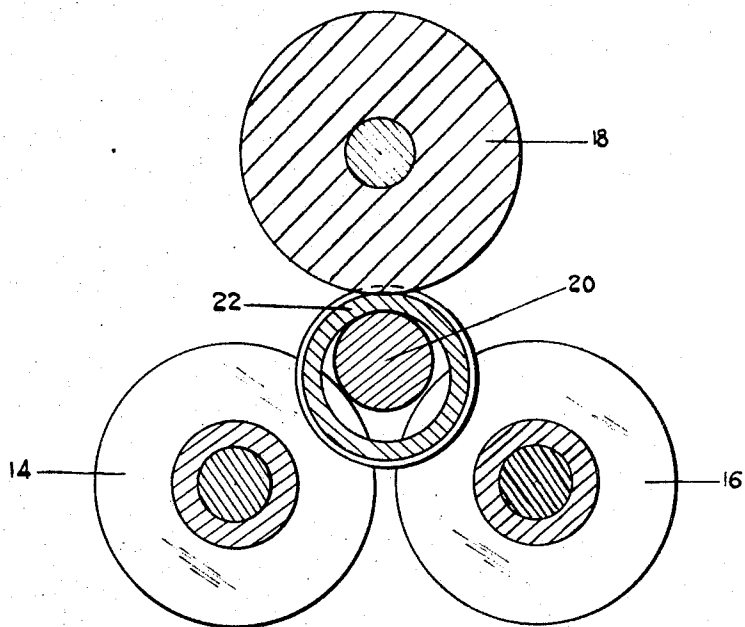
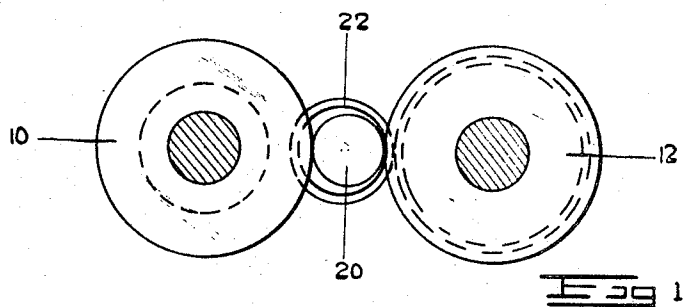


Fig 2

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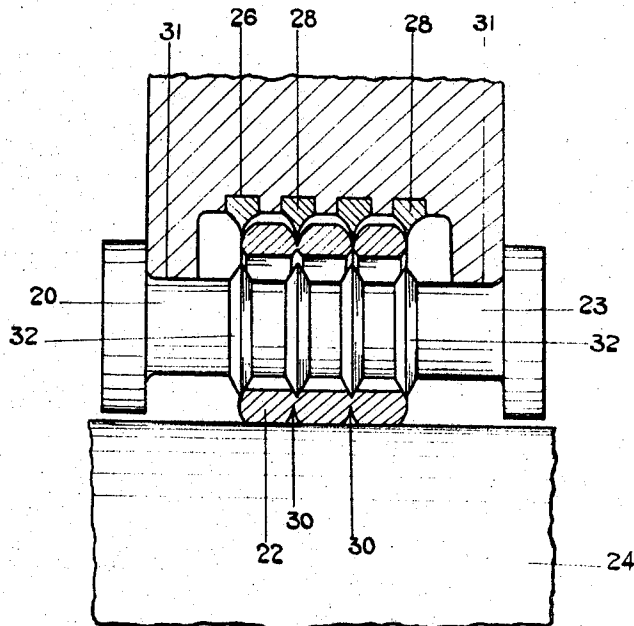
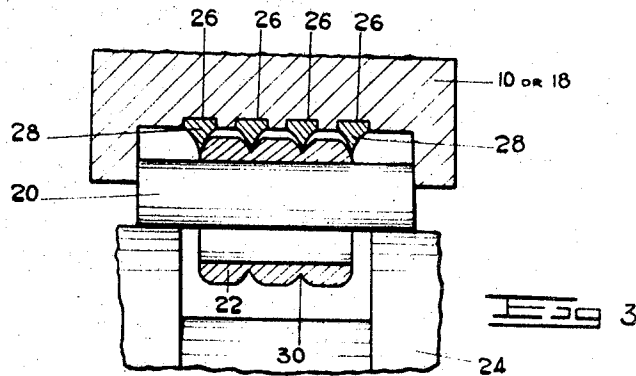
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6 Sheets-Sheet 2



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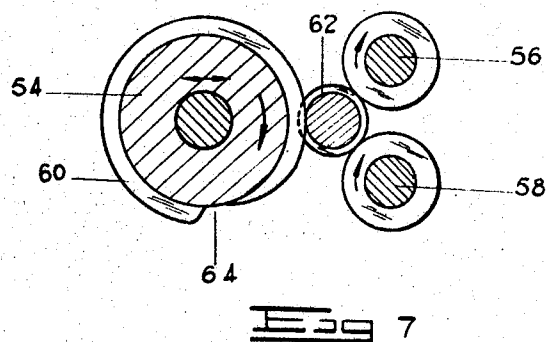
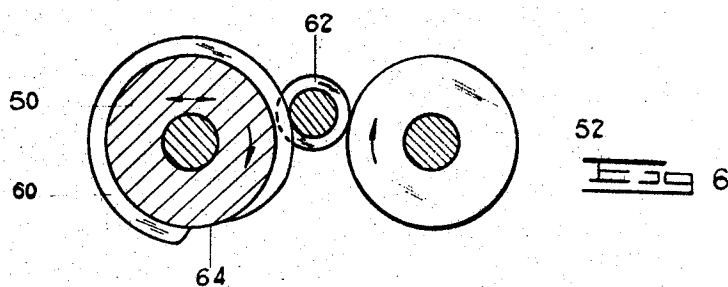
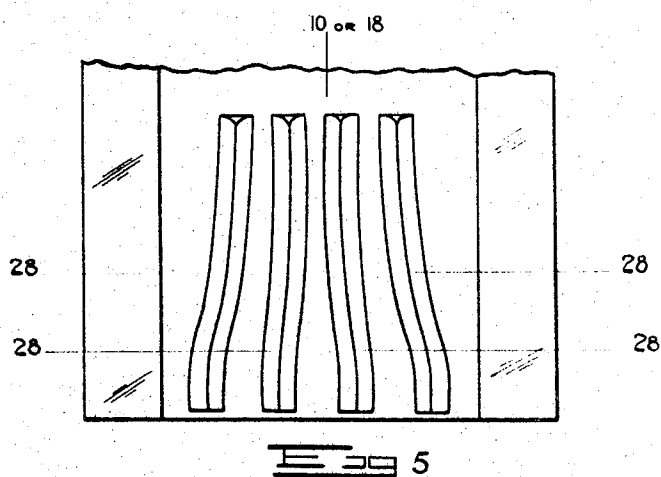
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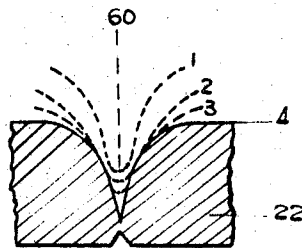


Fig 8

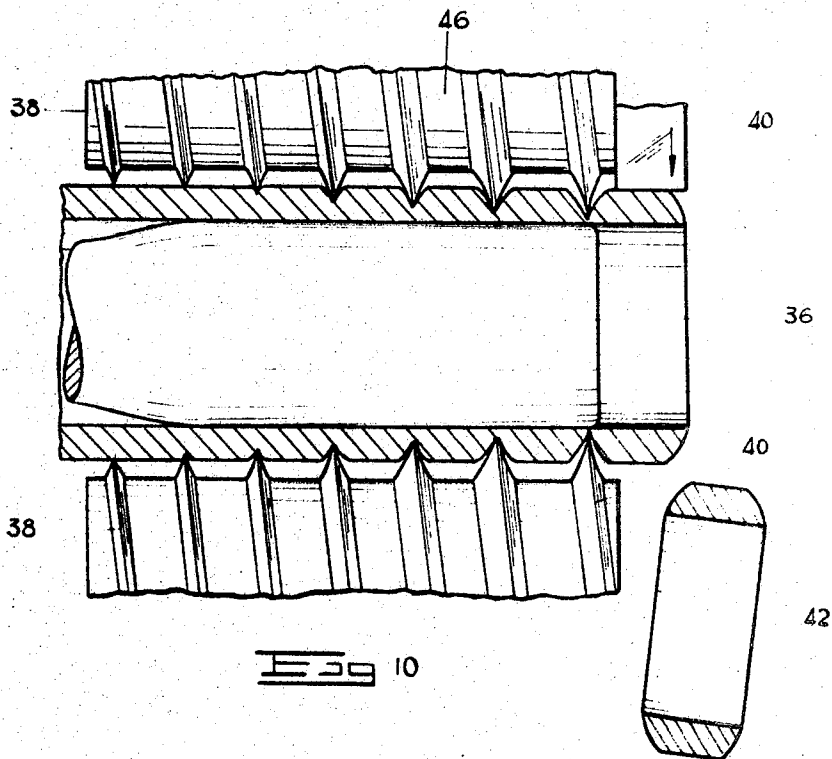


Fig 10

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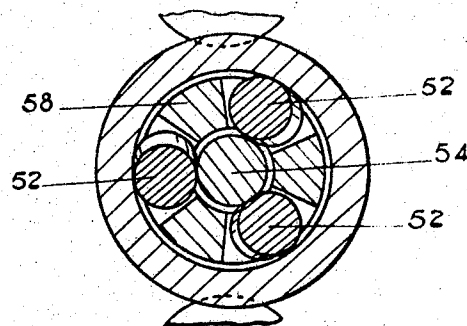
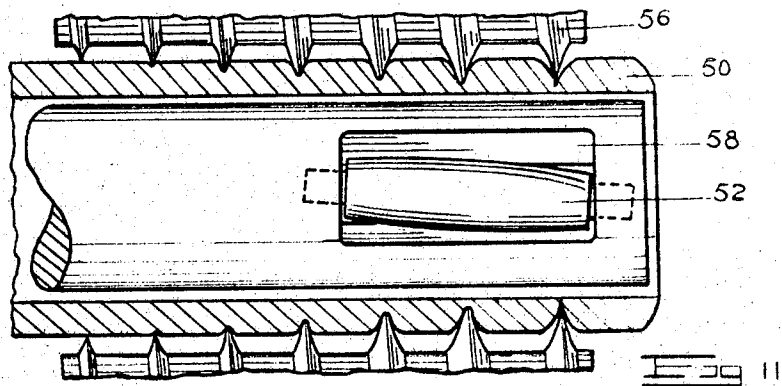
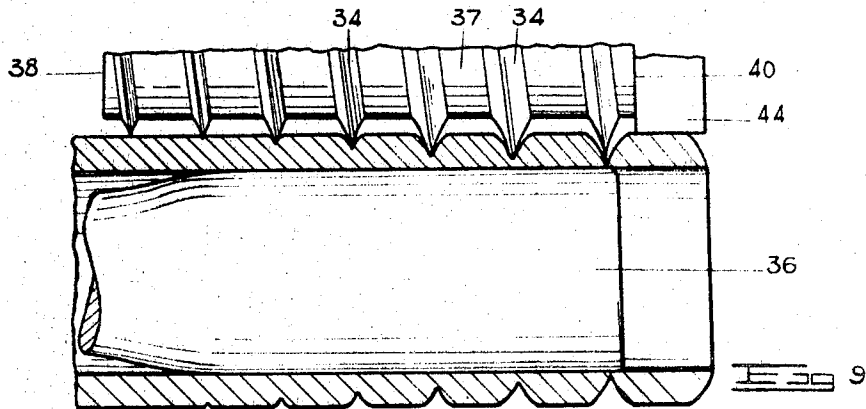


Fig 12

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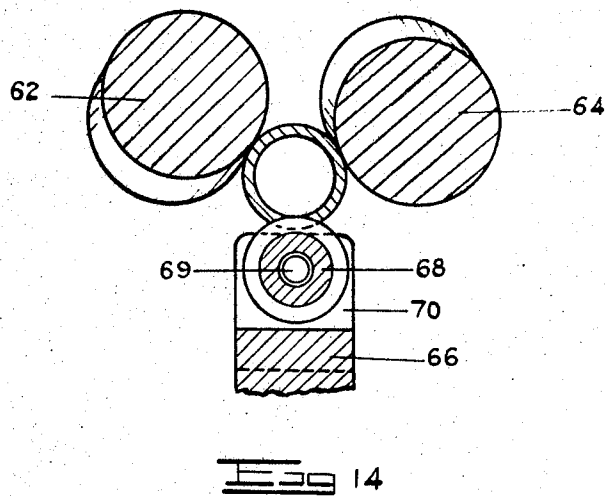
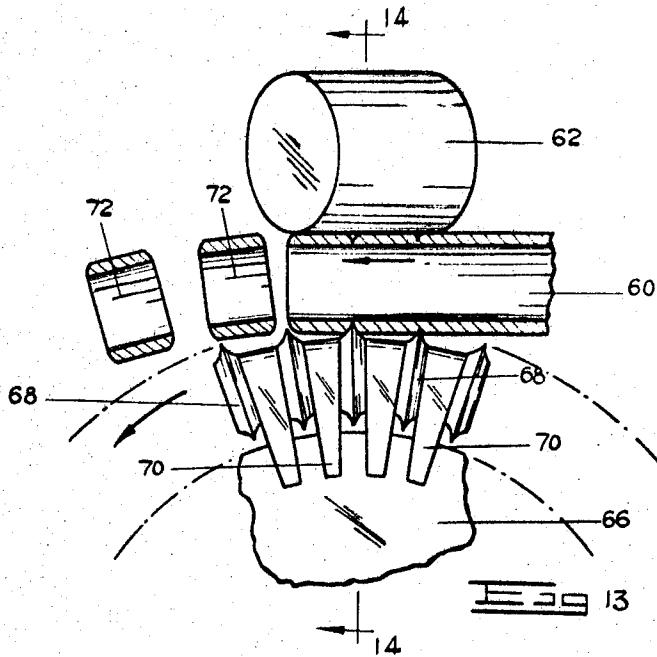
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3,470,775

PROFILING OF WORKPIECES

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Int. Cl. B23b 5/08

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3 Claims

ABSTRACT OF THE DISCLOSURE

Annular workpieces are parted by rotating them in contact with rotating profiling formations to indent them progressively more deeply around their peripheries. The profiling formations may be annular, or scrolls past which the workpieces are advanced axially, or a plurality of small profiling rollers around the periphery and across the width of a rotating roller that defines with a backing roller for the workpiece a profiling space through which the workpiece advances axially to be indented by the profiling rollers.

The object of the present invention is to provide a method of parting tubular workpieces which largely avoids the inconveniences of conventional methods.

By "parting" is meant not only the complete severance of the tube at a cross-section, but also an operation which, while stopping short of severance, leaves so slender a web that the workpiece is easily broken at the web.

According to the invention, the tubular workpiece is rotated relatively to a convergent profiling tool that is pressed against its surface to indent it progressively more deeply around its circumference. Further according to the invention, the workpiece is buttressed against the radial pressure of the profiling tool by means such as a mandrel, contained within the cavity of the workpiece. The mandrel may be formed with a sharp swage in the plane of the profiling tool, and that is held stationary relatively to the workpiece, not only to buttress the workpiece but to indent it in its inner surface to assist parting.

The term "convergent" is used to mean a tool the operative part of which converges towards a tip. A chisel would be such a tool, except that it converges to a cutting tip, whereas the tool of the invention has a profiling or indenting function, and no cutting function.

The mandrel may project beyond the workpiece at both ends and the projecting ends may roll on a surface which is one of juxtaposed surfaces that define between them a profiling space of diminishing extent, the profiling tool forming part of one of the surfaces, and the mandrel, as the throat is diminished in extent, squeezing the workpiece between itself and the profiling tool, to indent the tube and thereby part it.

In the vast majority of cases, the surfaces will be the peripheries of juxtaposed rollers, and, therefore, the specification will refer to the surfaces as rollers, but it is to be understood that a rectilinear surface, the equivalent of a segment of a roller of infinite radius, and a curvilinear surface which is the equivalent of a segment of a roller of very large radius, are considered to be in the ambit of the invention.

The rollers may be two in number, defining a convergent throat through which the mandrel and the workpiece advance, for the workpiece to be squeezed between the mandrel and the profiling tool as the throat progressively narrows, until, at the narrowest part of the throat, the parting operation has been completed. On the other hand, there may be three rollers which are movable rela-

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tively inwardly towards one another to diminish the profiling space defined between them, the mandrel ends rolling on two rollers and pressing the workpiece against the third, of which the profiling tool forms a part.

If the profiling tool rotates, it will be understood that it will be annular.

Several embodiments of the invention are illustrated in the accompanying drawings, in which:

FIGURE 1 is a diagrammatic view of a "two-roller" profiling system,

FIGURE 2 is a diagrammatic view of a "three-roller" profiling system,

FIGURE 3 is a vertical section through part of a profiling machine using a plain mandrel,

FIGURE 4 is a similar view, with a profiling mandrel,

FIGURE 5 is a developed view of the profiling roller,

FIGURE 6 is a diagrammatic view of a "two-roller" system with a cut-away profiling roller,

FIGURE 7 is a similar view of a "three-roller" system

FIGURE 8 is a fragmentary view of a sectioned workpiece, with the profiler contour shown dotted,

FIGURE 9 is a fragmentary view, partly in section of a scroll profiler,

FIGURE 10 is a similar view of a different machine,

FIGURE 11 is a fragmentary view, partly in section, of another form of backing mandrel,

FIGURE 12 is a section on the line 12—12 of FIGURE 10,

FIGURE 13 is a fragmentary view, partly in section, of another form of profiler, and

FIGURE 14 is a section on the line 14—14 of FIGURE 13.

In FIGURES 1 and 2, two arrangements of rollers are shown. In FIGURE 1 there are two rollers 10, 12 defining a convergent throat between them while in FIGURE 2 there are three rollers 14, 16, 18 defining a profiling space between them which is diminished in extent by inward movement of the roller 18. A mandrel 20 is threaded through the workpiece to be parted, 22, and projects from it at each end, the projecting ends rolling on the roller 12, or the rollers 14, 16. The roller marked 24 in FIGURE 3 is either the roller 12 of FIGURE 1 or the roller 14 of FIGURE 2.

The roller 10 or 18 has a series of parallel, annular inserts 26 let into its periphery to project from it as a series of convergent profiling formations 28 that, as the throat diminishes, either by advance of the mandrel through it (FIGURE 1) or by inward movement of the roller 18 (FIGURE 2), profile the workpiece to form indentations 30 which progressively grow deeper until, when the throat is at its narrowest, they either have pierced the workpiece and severed it, or have nearly done so.

The mandrel 20 itself may have a smooth surface 23 (FIGURE 4) to act as a backing which resists the radially inward pressure of the profilers 28 and prevents the tube from buckling; so it may have a series of sharp collars 32 in register with the profilers 28, that indent it in the planes of the indentations 30. They are located diametrically opposite the profilers 28. The tube is, in this case, robust enough to resist buckling. The mandrel rolls on lands 31 which cause the collars to indent the inside of the tube, opposite the grooves indented by the profilers 28, towards the end of the parting operation. The internal indentations assist parting and also prevent the formation of an internal ridge when the pipe is not backed against the profilers.

As the workpiece is progressively profiled, it spreads axially by reason of plastic flow of the material of the workpiece. It is, therefore, necessary, to cause the profilers 28 to be splayed outwardly as the profiling proceeds. A development of the profilers is shown in FIG-

FIGURE 5, in which it is seen that the profilers start parallel but diverge until, towards their ends, they become parallel again as the axial spread of the workpiece ceases. Naturally, the workpieces will have to be introduced into the profiling space in concord with the profilers, so that profiling commences when the profilers are at their minimum separation.

In a development of the machine of FIGURES 1 to 4, seen in FIGURES 6 and 7, juxtaposed rollers, 50, 52 (FIGURE 6) or 54, 56, 58 (FIG. 7) define between them a profiling throat which, in the case of FIGURE 6, converges by reason of the geometry of the machine, and in FIGURE 7, by reason of relative inward movement of the roller 54. In some machines with convergent throats, the rollers may be moved together to narrow the throat.

The roller 50 or 54 is formed with a spiral profiling formation 60 around its circumference. The tubular workpiece 62 within the profiling throat rotates as the rollers rotate, and, during a revolution of the roller 50 or 54, the profiling formation indents the surface of the workpiece around its circumference, more and more deeply, until, when the gap 64 which separates the end of the formation from its start is reached, the workpiece has been severed or at least so deeply indented that it can be ruptured easily.

As seen in FIGURE 8, it is not necessary that the profiling formation 60 be of uniform contour around the circumference. The initial contact with the workpiece 22 may indent it and the following elements of the formation progressively change the shape of the indentation, as shown by the contours 1, 2 and 3 in FIGURE 8, until the contour 4 is reached which provides the final indentation. Contours 1 to 3 will generally be divergent, to allow for axial spread of the workpiece, as shown in FIGURE 5. The contour 4 will be truly circumferential.

In the development of the invention shown in FIGURE 9, the parallel profilers 28 of the embodiment of FIGURES 1 to 4 are replaced by a profiling scroll 34 on a roller 37. The mandrel 36 is contained within the tube to be parted, to back it against the pressure of the profiler.

The profiling operation, in this embodiment, requires that the tubular workpiece should move axially as the scrolled roller 37 rotates. The scroll is increased in diameter from its start 38 towards its end 40. The tubular workpiece is offered to the scroll, and the scroll bites into the outer surface of the workpiece. Once the scroll has engaged the workpiece, axial advance of the workpiece is imposed by rotation of the scrolled roller, the mandrel maintaining the workpiece about a fixed axis, and the workpiece being rotated about that axis. As the workpiece advance and rotates, parallel grooves are indented into its surface, which are progressively increased in depth as the scroll increases in diameter, until, at the end of the scroll, the grooves indented into the workpiece either cause severance of the tube into annuli, as indicated at 42, (FIGURE 10) or leave merely a slender web which can be easily ruptured. In the latter case, a reciprocating knocker arm 44 or a roller may be provided to knock or push off the annuli one after the other.

In FIGURE 10 the two unscrolled rollers 46, 48 are shown defining between them a profiling space which narrows in the sense that each scroll increases in diameter from one end 38 to the other 40, or, in an alternative arrangement, in the sense that, while the scrolls are of the same diameter throughout, the axes of the rollers are inclined to provide a convergent throat. In either case, the scrolls are of the same hand and are so registered that grooves indented by one scroll are followed by the other. This arrangement has the advantage of better balance than has the machine of FIGURE 8.

The rollers in FIGURE 10 are each rotated, in the same direction.

It will be appreciated that there could be three or more rollers, each with its own scroll, and each rotated.

In all the arrangements with scrolled profilers, the pitch of the scroll should be increased from start to end in order to compensate for axial spread of the workpiece due to the profiling operation.

In FIGURES 11 and 12, the tubular workpiece 50 is located internally by a series of barrel-shaped rollers 52 arranged for rotation around a central holder 54. The number of rollers 52 is the same as the number of profiling scrolls which are juxtaposed to the workpiece 50 to indent it. Two such scroll profilers are indicated at 56 and it will be understood that there are three, one in respect of each roller 52. The rollers 52 are set obliquely to the axis of the holder 54, and their convex contour is such that they are in line contact with the inside face of the workpiece. As seen in FIGURE 12, the rollers are held spaced apart in a cage 58 that forms part of the holder.

In FIGURES 13 and 14, the tubular workpiece 60 is located between two skewed rollers 62, 64, which are concave so that they make line contact with the workpiece, and a roller 66. The roller 66 has a series of annular profilers 68 arranged radially around its periphery. Each profiler is rotatably mounted on a spindle 69 carried in an insert 70 which is fitted into a recess in the periphery of the roller 66.

The roller 66 is rotated, as are the rollers 62, 64. The workpiece is rotated and is offered to the convergent throat defined between the two rollers 62, 64, and the roller 66. As it meets the first of the first of the profilers 68, it is indented around its periphery and is caused to advance with the profiler into the throat. Other profilers then engage it, and the indentations made by the profilers around the circumference of the workpiece are progressively increased in depth, until, as the throat reaches its narrowest width, the workpiece is parted into one annulus 72 after the other, or the tube is so deeply indented that the slender web left between the annuli is easily severable.

The machines of the invention offer interesting possibilities in regard to the formation of annular blanks for other operations, such as rotary profiling of rings. Lengths of tube can quickly and accurately be parted into individual blanks. It is pointed out that the shape selected for the profilers will dictate the outer contour of the parted annuli, so that blanks can be "tailor-made" for the particular configuration which is to be applied to them. This permits important economies in respect of waste material, time and power input to be effected.

In the machines of the invention employing scrolled profilers, the contour of the roller or rollers between the turns of the scroll will determine the profile of the parted annuli, so that here, again, the blanks can be "tailor-made" to the job. In these machines, if the mandrel, or other backing means, be held within the profiling space and the workpiece moved over it, production of annuli is continuous and output is limited only by the necessity occasionally to recharge the machine with tubing.

I claim:

1. A machine for parting a tubular workpiece into individual annuli, comprising means to support the workpiece and rotate it about its axis, and a series of sharp-edged work rollers mounted to engage the workpiece and progressively indent it about its circumference; the means to support and rotate the workpiece comprising at least two backing rollers on which the workpiece is adapted to rest with the axes of the backing rollers skewed relative to each other and to the axis of the workpiece, and means to rotate the backing rollers so that the workpiece is rotated and simultaneously advanced in the direction of its axis; a wheel, the work rollers being mounted for rotation on the periphery of the wheel, the axis of the wheel being at right angles to the axis of the

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workpiece and so spaced from the axis of the workpiece that the work rollers successively engage the workpiece during rotation of the wheel and the backing members; and means to drive the wheel at a peripheral speed equal to the axial speed of the workpiece.

2. The machine of claim 1 in which the backing rollers are concave and have line contact with the workpiece, thereby to depress ridges raised by the work rollers at the edges of indentations the work rollers make in the workpiece.

3. The machine of claim 1 in which each work roller is mounted for free rotation on a spindle fixed in the periphery of the wheel.

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HARRISON L. HINSON, Primary Examiner

U.S. Cl. X.R.

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