Sept. 16, 1969 J. A. SULLIVAN 3,466,982

SLOTTING MECHANISMS

Filed Nov. 15, 1966 2 Sheets-Sheet 1

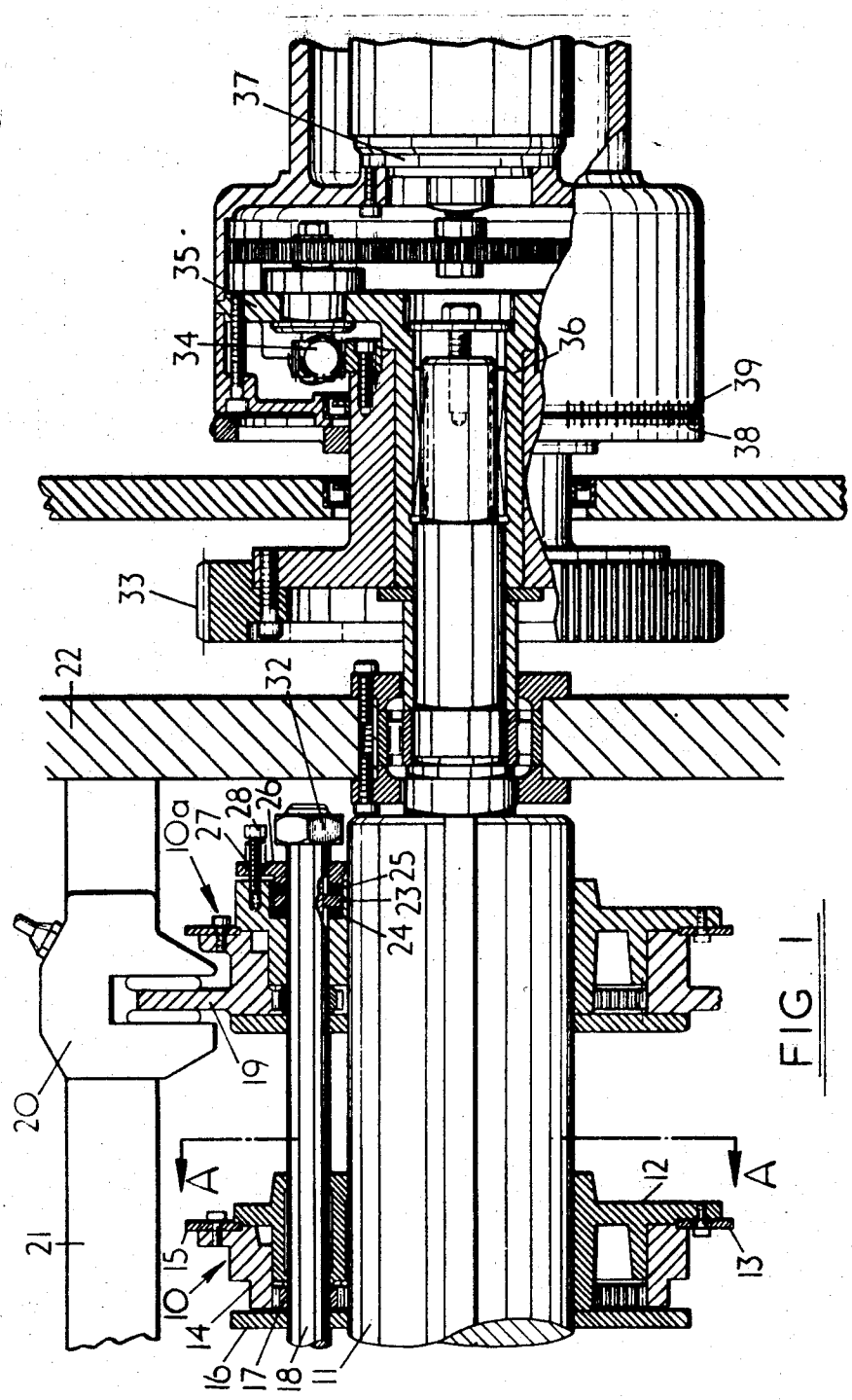


FIG 1

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SLOTTING MECHANISMS

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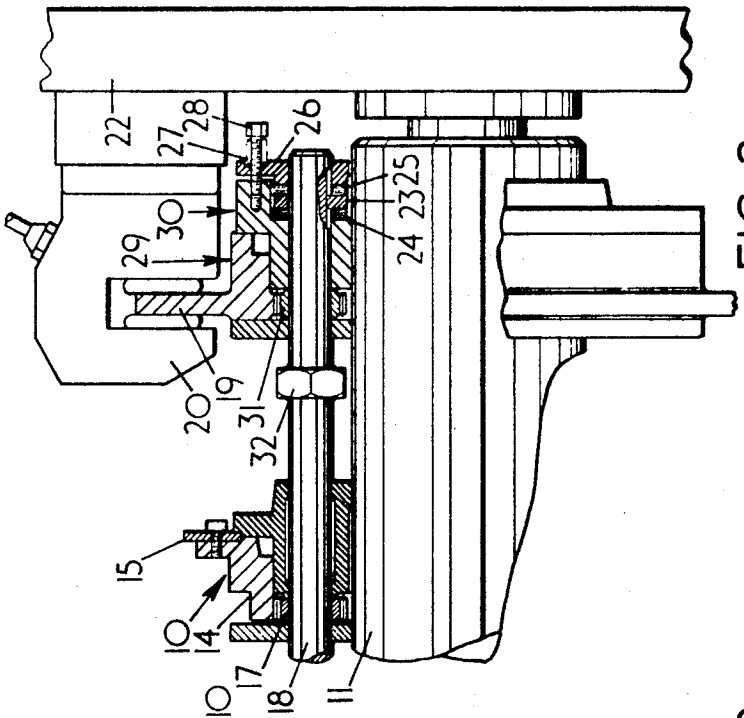


FIG. 3

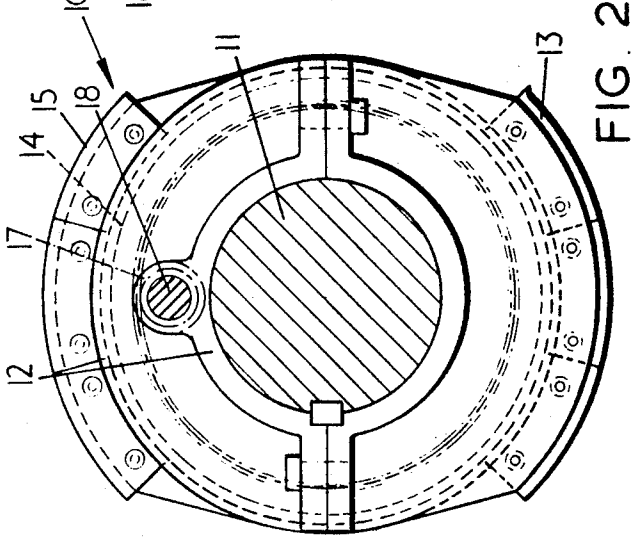


FIG. 2

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SLOTTING MECHANISMS

John Anthony Sullivan, Woods Moor, Stockport, Cheshire, England, assignor to Henry Simon Limited, Stockport, England, a British company

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U.S. Cl. 93—58.2 2 Claims

ABSTRACT OF THE DISCLOSURE

An arrangement for the simultaneous adjustment of the relative positions of aligned slot-cutting knives of a plurality of slotting knife units mounted for rotation on a common supporting shaft, and wherein each unit consists of a hub carrying one of two aligned slotting knives, an internally toothed annular flange rotatable on the hub and carrying the other said knife, and a pinion in toothed engagement with the annular flange and rotationally fixed on an adjusting shaft passing through the hubs of all said units and common to their pinions. The arrangement provides that during adjustment a braking disc extension of one of the said annular flanges is engaged by a relatively fixed brake shoe thus preventing the annular flanges of all units from rotating with their hubs when the hubs are rotated by their supporting shaft.

This invention relates to apparatus of a kind wherein slots or the like are cut in the leading and trailing edges of cardboard blanks as the said blanks are passed through the nips of one or more pairs of intermeshing rotary knife assemblies which are mounted for contra-rotation on a related pair of parallel contra-rotating shafts.

Where such cardboard blanks are to be used for the making of boxes, the leading edge slots and the trailing edge slots are in line along the path of movement of the blanks and they define the flaps which, when the blank is subsequently folded, form the tops and bottoms of the boxes. In such cases it is convenient and usual to arrange that the knife elements which cut the in-line slots are carried from the corresponding shafts on common mounting members, the leading edge slotting knife elements and the trailing edge slotting knife elements being so spaced circumferentially on their respective mounting members that the uncut portion of the blank defines the height of the folded box.

It will be appreciated that an intermeshing pair of rotary knife elements comprises a male slotting-knife element associated with one of the contra-rotating shafts and a female slotting-knife element associated with the other contra-rotating shaft. Normally the female slotting-knife element takes the form of a grooved annulus, the groove in which effects intermeshing engagement with both the male leading edge slotting-knife element and the trailing edge slotting-knife element when these two elements are in line with one another.

To provide for differences in box cross-sectional requirements the knife mounting members are axially movable on their driving shafts, and it is known to provide that the mounting members for the intermeshing components of the pairs of knife elements may be simultaneously moved axially to a required position by remotely controlled means.

To cater for differences in box height requirements it is necessary to change the circumferential spacing of the leading edge and trailing edge male slotting-knife elements, and, except where the female slotting-knife element is an annulus, to change by a similar amount the

circumferential spacing of the leading edge and trailing edge female slotting-knife elements. For conveniently performing such change of circumferential spacing it is known to arrange that, for each slotting-knife mounting member, the knife element associated with one edge of the cardboard blank is fixed directly to the shaft-driven mounting element, while the knife element associated with the other edge of the cardboard blank is fixed to an annulus which is freely rotatable on the shaft-driven mounting element, the knife fixing arrangements ensuring that the two knife elements are circumferentially in line so that the slots which they cut will be in line along the path of movement of the said blank, and there being provided means which retain the said annulus in a desired rotationally fixed relationship with its associated mounting member.

British patent specification No. 959,107 describes such a retaining means wherein a gear formed on the said annulus meshes with a pinion mounted on a pinion-shaft rotatably carried by journal bearings in the machine main frame structure which pinion-shaft in normal operation is positively driven at a speed which ensures that the annulus rotates at the same speed and in the same direction as the member on which it is mounted so that there is no relative movement between the annulus and its associated mounting member and consequently no change in the circumferential spacing of the associated knife elements. The aforesaid patent specification also describes further means whereby the said pinion-shaft and pinion can be rotated in a manner which will cause the annulus to rotate by a predetermined amount relative to its mounting member thus changing the circumferential spacing between the associated in-line knife elements, and it is also disclosed that the said pinion-shaft may simultaneously drive similar pinions and their associated annuli for all rotary knife units mounted on a common shaft.

It is a disadvantage of known relationship-retaining and circumferential spacing adjustment means that the method of driving such a pinion-shaft entails the provision of a gear train, and it is a further disadvantage that the gear teeth of the associated pinions and gears are exposed to possible damage and dust fouling.

The object of this invention is to provide means for retaining or adjusting the circumferential spacing of knife elements which mitigate the aforesaid disadvantages.

According to this invention a slotting mechanism comprising a rotatable main-shaft, a plurality of knife mounting assemblies mounted on the shaft each including a flanged hub rotatable with the shaft, a knife element fixed to the flange of the hub against rotation relative thereto, a geared annulus mounted co-axially on the flanged hub so as to be freely rotatable thereon, a knife element fixed to the annulus against rotation relative thereto and in such manner as to locate the knife element circumferentially in line with the knife element fixed to the flange of the associated hub, a pinion meshing with the teeth of the geared annulus, and a common pinion-shaft co-axial with all the pinions and rotationally fixed thereto, and wherein the geared annuli have internal gear teeth and the common pinion-shaft passes through the said flanged hubs and can rotate freely about its own axis therein, has a brake-ring provided on the said annulus of one of the knife mounting assemblies or on an annulus of an equivalent assembly not equipped with knife elements but to which the common pinion-shaft extends and a brake-shoe element of the fixed structure of the mechanism arranged so that it can be brought into engagement with the said brake-ring to prevent it from rotating with the assembly on which it is carried so that rotation of the main-shaft will cause the associated pinion and pinion-shaft to rotate and thereby through the intermediaries of the pinions of the, or of the other, knife mount-

ing assemblies move the associated annuli rotationally relative to the flanged hubs thereby changing the circumferential spacing of all the in-line knife elements.

The mechanism for engaging the relatively fixed brake-shoe with the brake-ring may be of a kind which can be remotely controlled.

There may be a clutch or equivalent device associated with the pinion-shaft to prevent it from rotating relative to the assemblies when the brake is out of action.

The pinions associated with the knife mounting assemblies are axially slidable on the pinion-shaft so that they will accompany those assemblies when they are moved axially on the rotatable main-shaft.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings in which:

FIGURE 1 is a fragmentary view of a slotting mechanism embodying the invention, with certain parts shown in cross-section;

FIGURE 2 is a cross-sectional view of FIG. 1 in the direction of arrows A; and,

FIGURE 3 is a fragmentary view of an alternative form of part of FIG. 1.

In the embodiment of the invention shown in FIG. 1, a plurality of axially adjustable knife mounting assemblies **10**, only two of which are shown, is mounted in axially spaced rotationally fixed arrangement on a rotatable main-shaft **11** comprising one of a contra-rotating pair, each said knife mounting assembly including, a flanged hub **12** which is keyed to the main-shaft and carries on its flange a rigidly fixed knife element **13**, an internally geared annulus **14** which is mounted co-axially on the flanged hub and is freely rotatable thereon, a knife element **15** which is rigidly fixed to the annulus in such manner as to be circumferentially in line with the knife element fixed to the flange of the flanged hub, a thrust ring **16** fixed to the flanged hub to prevent relative axial movement of the said annulus, and a pinion **17** meshing with the teeth of the internal gear of the annulus; there being a common pinion-shaft **18** which is co-axial with and rotationally fixed in the pinions of all the axially spaced knife mounting assemblies the said pinion-shaft passing through the flanged hubs of the said assemblies and being freely rotatable therein. The geared annulus of a preferred one **10***a* of the knife mounting assemblies is provided with a co-axial brake-ring extension **19**, and there is in association therewith, a brake-shoe member **20** carried by an extension **21** of the fixed main frame **22** of the machine in such manner that it can at will be brought into braking engagement with the said brake-ring to prevent it and its associated geared annulus from rotating with the flanged hub on which the annulus is rotatably mounted, such arrangement providing that if the main shaft and its associated flanged hubs are caused to rotate while the brake-shoe is in braking association with the brake-ring, the consequent gyration of the pinion-shaft relative to the braked annulus causes the associated pinion and pinion-shaft to rotate about their common axis and thus transmit the relative rotational movement of the annulus and flanged hub to all knife mounting assemblies served by the pinion-shaft.

In the alternative embodiment shown in FIG. 3, the brake-ring extension **19** forms part of internally geared brake-annulus **29** mounted in a freely rotatable manner on support hub **30** which is rotationally fixed on the main shaft, the said support hub providing a journal bearing for an extension of the aforesaid pinion-shaft which, in a rotationally fixed manner engages a pinion **31** meshing with the teeth of the internal gear of the said brake annulus.

To prevent the pinion-shaft from rotating in its journal bearings when the brake-shoe is disengaged from the brake-ring extension, an axially slidable friction washer **23** which is rotationally fixed in a co-axial manner on the pinion-shaft is sandwiched between friction discs **24** and **25** which are axially slidable but rotationally fixed in a suitable recess in the hub on which the annulus having the brake-ring extension is mounted, and there being an adjustable pressure plate **26** which holds the said washer and discs in frictional association and is pre-set to provide a predetermined loading by a plurality of compression spirngs **27** that are co-axially mounted on adjustment screws **28** which are in screw-thread engagement with the said hub.

In normal operation the pinion-shaft gyrates round the axis of the main-shaft without itself rotating in its journal bearings, and consequently the related pinions hold their associated annuli at the predetermined position which provides a required circumferential spacing of the in-line knife elements. When however it is required to change such circumferential spacing, the brake-shoe element is brought into engagement with the brake-ring, and the main-shaft and its rotationally fixed members are rotated by a required amount.

To provide for the manual adjustment of the circumferential spacing of the knife elements, the pinion-shaft is provided with turning means **32** whereby it can be rotated by means of a hand-tool such as a spanner or a tommy-bar.

The brake-ring may be of disc-like form and the brake-shoe element may be of a known caliper type.

A scale or pointer associated with the brake-ring extension may be set against a pointer or scale associated with the hub on which the annulus having the brake-ring extension is mounted, to indicate the amount by which the knife elements are circumferentially spaced.

The invention is particularly applicable to the kind of slotting machine wherein adjustment means are provided to enable the said main-shaft to be rotated relative to its driving means and the blank feeding mechanism associated therewith. FIG. 1 illustrates such an arrangement wherein the driving gearwheel **33** is rotationally fixed to the main shaft through the intermediary of gearing elements **34** supported from the flange **35** of a hub-member **36** which is keyed to the main shaft, the said gearing elements being operable by an electric motor **37**, actuation of which causes the flanged hub-member and the main shaft to which it is keyed to rotate slowly relative to the driving gearwheel. In such a machine wherein the position of the knife elements on the flanged hubs **12** of knife mounting assemblies **10** are set in a precise relationship to the rotational position of the driving gearwheel **33**, a scale **38** associated with the said driving gearwheel may be set against a similar scale **39** associated with the main-shaft and its relatively fixed flanged hub-members to show the amount by which the knife elements are circumferentially spaced.

In a preferred arrangement wherein adjustment of the circumferential spacing of the knife elements is effected by use of the motor driven means whereby the main-shaft is rotated relative to its driving means and the blank feeding mechanism associated therewith, the electric circuits whereby the motor of the said means is caused to rotate in a required direction include a two-way switch that in one of its positions enables the main-shaft and all its knife assemblies to be rotated relative to its driving means in a conventional manner by actuation of an appropriate one of alternative direction determining switches, and in its other position causes the main driving motor of the machine to be isolated from its power source and at the same time causes the engagement of the brake means to prevent the geared annuli of the knife assemblies from rotating with the main-shaft when the motor of the said means is energised as a result of the actuation of either of the said direction determining switches, and there being in the power circuit of the motor of the said means the energising coil of a current sensitive relay adjusted to operate at the stalled current of the associated motor and arranged so that when operated by the stalling of the motor it opens the motor energising circuit but itself

remains in the operated condition causing actuation of signal means until its energising circuit is broken by release of the related direction determining switch.

With the means of the preferred arrangement, simultaneous identically similar adjustment of the circumferential spacing of the aligned knife elements of all the knife mounting assemblies is effected by first setting the two-way switch to the position where it isolates the main driving motor of the machine and causes application of the brake which prevents rotation of the said geared annuli, and then actuating one of the direction determining switches to cause the main-shaft to rotate relative to its driving means and the braked geared annuli of the knife assemblies until the relatively moving aligned knife elements of the said knife assemblies abut one another. The motor of the means then stalls causing its associated relay to operate to open the circuit of the said motor and at the same time provide a signal indicating that the knife elements are, according to the direction in which the main-shaft has been relatively rotated, either at the position affording maximum box height or at the position of zero box height. The actuated direction determining switch is then released and the alternative direction determining switch is actuated to cause the main-shaft to rotate in the opposite direction until reference to scales such as **38** and **39** of FIG. 1 shows that the knife element circumferential spacing which will provide for a box of the required height has been achieved. Thereafter the two-way switch is set to its other position so as to release the brake, and the appropriate direction determining switching is actuated to cause rotation of the main-shaft and its knife assemblies to the position of predetermined relationship with its driving means and the associated blank feeding mechanism.

A particular advantage of our invention is that the spacing adjustment gears and pinions are all encased within the knife mounting assemblies so that they are protected against damage and fouling, and can be adequately lubricated.

What is claimed is:

1. An arrangement for adjusting the relative positions of aligned slot-cutting knives in a rotary devices for making slots in blanks for folded boxes, comprising at least two slotting knife units mounted upon the slotting knife shaft each consisting of a hub secured against relative rotation thereon and having a slotting knife rigidly fixed thereto and a toothed annular flange rotatable on the hub and having a slotting knife fixed thereon and a pinion which is rotationally fixed upon a common adjusting shaft and engages the toothed annular flange which common adjusting shaft passes through the hubs of the slotting knife units, characteristed in that the annular flange rotatable on at least one of the hubs is formed as a braking disc and there is provided a brake shoe supported by the fixed structure which brake shoe engages the said braking disc during adjustment to prevent the said annular flange and the annular flanges in geared association therewith from rotating with the slotting knife hubs as the said hubs are rotated by the slotting knife shaft to adjust the relative positions of the said aligned slot-cutting knives.

2. An arrangement according to claim **1** wherein adjustment control means indicates that the aligned slot-cutting knives are at the limits of adjustment.

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WILLIAM S. LAWSON, Primary Examiner

U.S. Cl. X.R.

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