

[54] **METHOD AND DEVICE FOR BREAKING AWAY PRESTAMPED PIECES OF MATERIAL IN SHEET-LIKE WEBS**

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[56] **References Cited**

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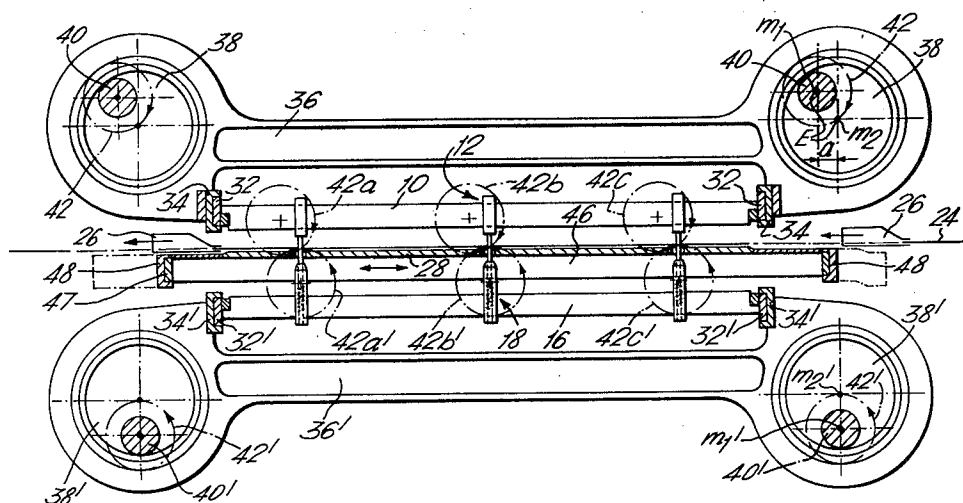
[57] **ABSTRACT**

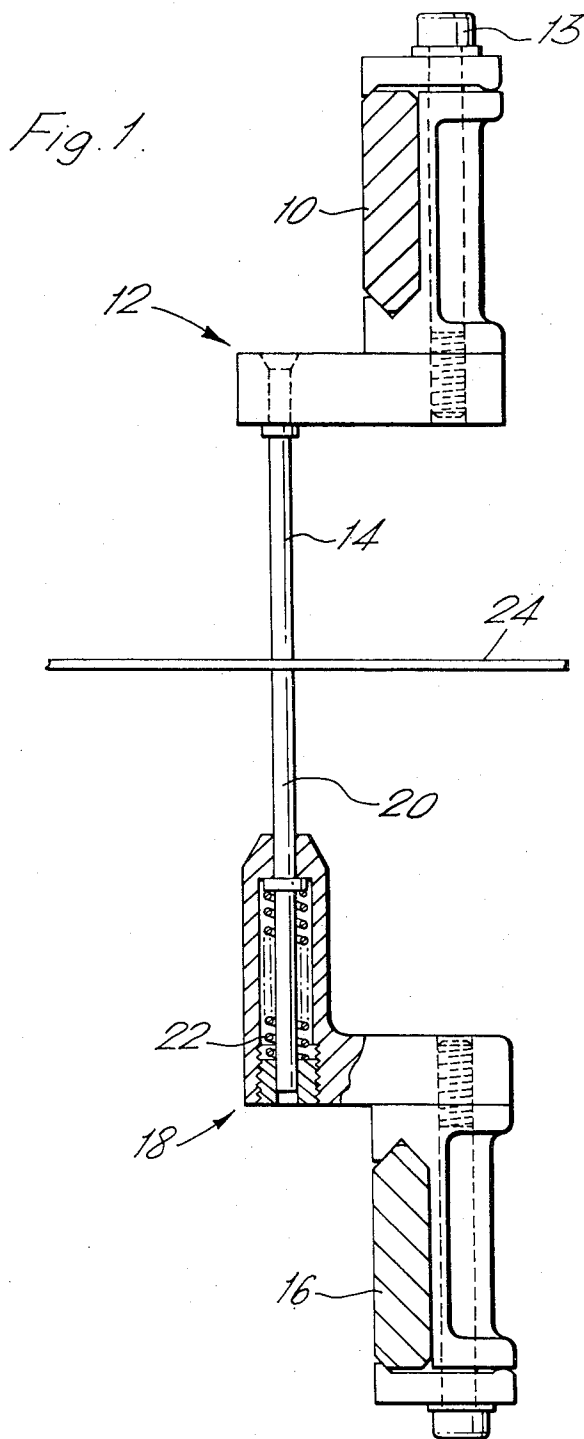
A method of breaking away pre-stamped pieces of material in sheet-like webs of material comprises moving such a web of material in the direction of its length, progressively bringing a break-away matrix up to the speed of movement of the web to make surface contact with one side of the web on attaining speed synchronism therewith, also progressively bringing up to the speed of movement of the web pairs of members whereof one of each pair is at each side of the web to grip therebetween on attaining speed synchronism with the web pieces of material to be broken away from the web, and breaking away the so-gripped pieces of material against the support of the matrix.

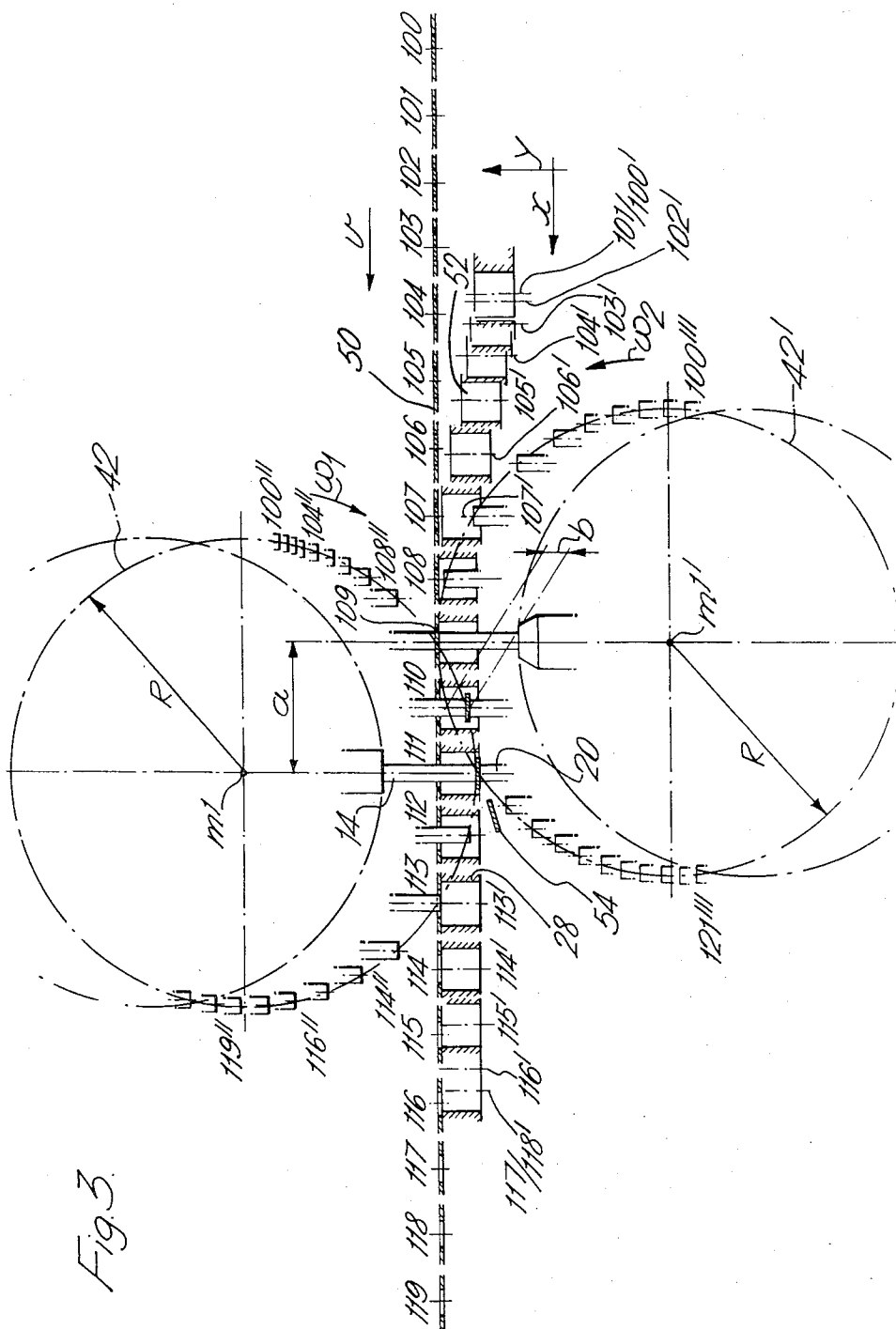
A device for carrying out the method comprises means for progressing such a web along a plane in the direction of its length, networks of rigidly-mounted

break-away pins mounted in first and second carriers which are mirror images of one another one above and one below said plane, the first and second carriers being mounted in the frame of the machine at a break-away zone of a stamping machine for movement towards and away from said plane with the axes of the break-away pins normal to said plane and the lower break-away pins resiliently displaceable in the directions of their lengths, a third carrier supported in said frame below said plane and mounting a matrix having through-openings each co-axial with an upper and a lower break-away pin, and means for guiding the first, second and third carriers each along a path of movement in relation to the movement of the web with appropriate correlation of the break-away pins and the through-openings in the break-away matrix with the pieces of material to be broken away such that in a first section the three carriers are accelerated from starting positions to the speed of the web, in a second section at least between the start and finish of the break-away operation the three carriers move synchronously with the web, in a third section the three carriers are decelerated, and in a fourth section the three carriers are returned to their starting positions, the path of movement of the first carrier including a phase of downwards movement towards said plane and substantially coincident with its first and second sections and a phase of upwards movement away from said plane and substantially coincident with its third section, the path of movement of the second carrier including a phase of upwards movement towards said plane and substantially coincident with its first section, and a phase of downwards movement away from said plane and substantially coincident with its second and third sections, and the path of movement of the third carrier including a phase of upwards movement towards said plane until the matrix is applied against the web, said phase being substantially coincident with its first section, and a phase of downwards movement away from the web and falling into the end of its fourth section.

6 Claims, 3 Drawing Figures







METHOD AND DEVICE FOR BREAKING AWAY PRESTAMPED PIECES OF MATERIAL IN SHEET-LIKE WEBS

The present invention relates to a method of breaking away pre-stamped pieces of material from sheet-like webs of material in which the web of material is applied against a break-away matrix, the pieces of material which are to be broken away are fully restrained from the two opposite sides of the web of material and are then separated out from the web of material against the supporting action of the breakaway matrix.

Such a method has hitherto been proposed, more or less, in German Pat. No. 1,149,976 and has proved completely reliable. However, in connection therewith, it is necessary to bring the web of material to a halt on each occasion in order to grip the pieces of material to be broken away and separate them from their connection with the web of material. There thus arises inevitably an undesirable discontinuous mode of operation which as a result of the relatively long idle periods resulting therefrom involves a comparatively long operating time together with expenditure of energy from the continuous slowing down and acceleration of the web of material on each occasion leading into or out of the idle period, as well as the requirement for increased mechanical strength to be able to cope with the large slowing-down and speeding-up forces.

The object of the present invention, therefore, is to provide a method of the kind hereinbefore set forth with the aid of which the breaking away of pre-stamped pieces of material can take place continuously on a moving web of material, so that no idle periods prolonging the operating time have to be taken into account, nor need there be applied any special deceleration and acceleration forces for the continuous stopping and starting of the web of material.

According to the present invention, we provide a method of breaking away pre-stamped pieces of material in sheet-like webs of material, comprising moving such a web of material in the direction of its length, progressively bringing a break-away matrix up to the speed of movement of the web to make surface contact with one side of the web on attaining speed synchronism therewith, also progressively bringing up to the speed of movement of the web pairs of members whereof one of each pair is at each side of the web to grip therebetween on attaining speed synchronism with the web pieces of material to be broken away from the web, and breaking away the so-gripped pieces of material against the support of the matrix.

Also, according to the present invention, we provide a device in a stamping machine for breaking away pre-stamped pieces of material in sheet-like webs of material in a breakaway zone of the machine, said device comprising means for progressing such a web along a plane in the direction of its length, networks of rigidly-mounted break-away pins mounted in first and second carriers which are mirror images of one another one above and one below said plane, the first and second carriers being mounted in the frame of the machine at the break-away zone for movement towards and away from said plane with the axes of the break-away pins normal to said plane and the lower break-away pins resiliently displaceable in the directions of their lengths, a third carrier supported in said frame below said plane and mounting a matrix having through-openings each co-axial with an upper and a lower break-away pin, and

means for guiding the first, second and third carriers each along a path of movement in relation to the movement of the web with appropriate coorelation of the break-away pins and the through-openings in the break-away matrix with the pieces of material to be broken away such that in a first section the three carriers are accelerated from starting positions to the speed of the web, in a second section at least between the start and finish of the break-away operation the three carriers move synchronously with the web, in a third section the three carriers are decelerated, and in a fourth section the three carriers are returned to their starting positions, the path of movement of the first carrier including a phase of downwards movement towards said plane and substantially coincident with its first and second sections and a phase of upwards movement away from said plane and substantially coincident with its third section, the path of movement of the second carrier including a phase of upwards movement towards said plane and substantially coincident with its first section, and a phase of downwards movement away from said plane and substantially coincident with its second and third sections, and the path of movement of the third carrier including a phase of upwards movement towards said plane until the matrix is applied against the web, said phase being substantially coincident with its first section, and a phase of downwards movement away from the web and falling into the end of its fourth section.

With this device it is ensured that the gripping of the pieces of material to be broken away can be effected by means of break-away pins directly on the web of material passing the break-away zone or station, and the various elements necessary for carrying out the break-away operation can be driven in a continuous and preferably rotary movement, so that likewise there is no necessity of slowing down to an idle state nor acceleration away from the idle state.

The second section of the path of the third carrier is preferably longer than the second sections of the upper and lower carriers, so that the break-away matrix is certain to be moving in synchronism with the web of material when the break-away pins engage with the web.

Particularly favourable conditions occur when the carriers are mounted in each case by means of an eccentric drive ensuring that they are guided parallel to the guide plane of the web of material, with the eccentricity corresponding to the movements towards and away from said plane adapted to the duration of the break-away movement, and the upper carrier is offset in relation to the lower frame by a distance in the direction of movement of the web of material equivalent to the movement section which is between the beginning and end of the break-away operation. The eccentric mounting of the break-away pins may be effected by means of carriages extending parallel to the travel direction of the web of material, which carriages are mounted at their ends by crankpins of crankshafts which run in synchronism and in phase with regard to a carriage. The crankshafts of the upper carriage on one half and of the lower carriage on the other may, on the contrary, be displaced in phase in a suitable manner so that the cooperation of the upper and lower break-away pins is realised in the manner desired.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawing, in which:

FIG. 1 shows diagrammatically in its original size the basis design of an upper tool together with a lower tool, operating in conjunction therewith, with break-away pins engaging with a web of material, as has already been proposed in the art;

FIG. 2 shows diagrammatically, in section, a side view of break-away device according to the invention for breaking away pre-stamped pieces of material from a moving web of material; and

FIG. 3 shows diagrammatically, and on a larger scale, a side view of a section from FIG. 2 which makes clear in more detail the sequence of movements of the different elements of the break-away device according to the invention in the course of a break-away operation.

FIG. 1 shows diagrammatically and separately the construction of a break-away device, as it is known in the art. On a crossbeam 10 fixed to the machine frame (not shown) there is clamped an upper tool, generally designated by the reference numeral 12, which can be shifted lengthwise of the crossbeam 10 by slackening off or tightening a bolt 13 and can moreover be swung about the longitudinal axis of the bolt 13. The upper tool 12 includes break-away pin 14 which acts on a web 24 of material containing the pre-stamped pieces of material, when a breaking-away operation is to be carried out.

On the underside of the web 24 of material there is clamped in similar manner on a crossbeam 16 a lower tool which acts through a break-away pin 20 on the web 24 of material and in doing so is opposite the break-away pin 14, so that the piece of material to be broken away can be held by the two break-away pins 14 and 20. The break-away pin 20 of the lower tool generally designated 18 is displaceably mounted for movement lengthwise of itself against the action of a spring 22, so that it can yield, when an actual breaking-away movement is effected, by moving the break-away pin 14 downwards on to the web of material — whilst maintaining the clamping action on the piece of material to be broken away.

A plurality of such break-away devices with upper tools 12 and lower tools 18 is secured, like a network in each case, to first or upper and second or lower carriers with the crossbeams 10 and 16. A break-away matrix (not shown in FIG. 1) mounted on the underside of the web 24 of material protects the web 24 of material when the prestamped pieces of material are to be broken away by moving the upper tool 12 downwards. Suitable recesses in the breakaway matrix ensure unimpeded displaceability of the upper and lower tools 12 and 18.

Whereas the known break-away devices according to FIG. 1 are fixed to the frame of the machine in such a way that the only movement of the break-away pins 14 and 20 which is possible is in the direction of their longitudinal axes and thus the web of material has to be stopped every time a breaking-away operation is effected. According to the invention provision is made for mounting the break-away device relative to the machine frame, so that displacement is possible also in the direction of travel of the web 24 of material.

FIG. 2 shows such an arrangement. The crossbeam 10 and 16 supporting the upper and lower tools 12 and 18 extend in known manner at their free ends into lateral first and second carriers 32 and 32' by means of which they are located in rails 34 and 34' of a U-shape profile. The U-shaped rails 34,34' are fixedly con-

nected with carriages 36 whose ends opposed in the direction of travel of the web 24 of material have appropriate bearing openings for accommodating crankpins 38 and 38' of cranks shafts 40 and 40'. The mid-points $m1$ of the crankshaft 40 and $m2$ of the crankpin 38 are spaced apart a distance E corresponding to the eccentricity of the crankpin 38 on the crankshaft 40. As the crankshaft 40 rotates the mid-point $m2$ therefore moves along a circular path 42 around the mid-point $m1$. The same is true basically with regard to the mounting of the lower carriage 36', in which the mid-point $m1'$ of the crankshaft 40' and the mid-point $m2'$ of the crankpin 38' are again spaced apart a distance E so that the mid-point of the crankpin 38' moves along a circular path 42' but in the opposite direction to mid-point $m2$. In the present embodiment the rotation of the mid-point $m2$ is clockwise, whereas the rotation of the mid-point $m2'$ is counterclockwise. The mid-points $m1'$ of the crankshafts 40' of the lower carriage 36' are, moreover, for further reasons to be explained hereinafter in connection with FIG. 3, arranged a distance a before (in relation to the direction of travel of the web 24 of material) mid-points $m1$ of the crankshafts 40 of the upper carriage 36. The working surfaces of the break-away pins of the upper and lower tools 12,14 therefore likewise pass through the circular paths 42a, 42b, 42c and 42a', 42b', 42c' corresponding to the paths 42 and 42', the paths 42a and 42a', 42b and 42b' having in each case mid-points displaced in relation to one another analogous to the distance a .

As the web of material or a sheet of material is supplied through the diagrammatically illustrated gripper rails 26 in a direction from right to left — relative to FIG. 2 — the upper and lower tools can therefore be brought against the web of material in clockwise and counter-clockwise circular motion, respectively, with progressive acceleration up to the speed of travel of the web 24 of material, can then grip and break away the pieces of material to be broken away as they move at the same speed, in order subsequently to be guided with gradual deceleration away from the guide plane of the web of material again and returned to their starting positions.

In a similar manner the break-away matrix 28 is mounted so that it can be moved both in the direction of travel of the web 24 of material and perpendicular to it. The mounting is preferably such in this case that the break-away matrix 28, which is supported by crossbeams 46, in a similar manner to the upper and lower tools 12,18, and is guided by means of these crossbeams 46 so that it can be displaced in a third carrier 47 which is seated in rails 48 of a U-shaped profile connected to the machine frame. In its starting position the matrix is at a predetermined distance normal to the guide plane of the web of material. From this spaced position the break-away matrix, in a similar manner to the tools 12,18, can be brought, with progressive acceleration upon to the speed of travel of the web 24 of material, against the web 24 of material and can then move in synchronism with the latter until the breaking-away operation has been completed. Thereafter the breaking-away matrix 28 can then be returned along the same path to its starting position or else be moved away from the web 24 of material perpendicular to the guide plane and be returned to its starting position at a distance from the web of material.

In the diagrammatical illustration of FIG. 3 there is particularly shown the sequence of movement of the three elements of the breaking-away device, i.e., the upper and lower tools as well as the break-away matrix, with division into individual part-phases corresponding to one another. The crankpins 38 and 38' run in the clockwise and counterclockwise direction with the angular velocities w_1 and w_2 , these angular velocities not being constant, however, but being of different values in each case according to the angular position of the crankpin. At the same time the working surfaces of the break-away pins 14 and 20 move — as has already been explained with reference to FIG. 2 — along the circular paths 42 and 42' which each have their mid-point m_1 or m_1' . The mid-point m_1' is located in relation to the travel of the web of material — at the distance a before the mid-point m_1 .

The break-away matrix 28 of which, as with the networks of break-away pins 14 and 20, only a representative section is shown in each situation, performs a reciprocatory movement commencing in the direction of the arrow x , this reciprocatory motion being moreover accompanied in the initial stage by an upwards movement in the direction of the arrow y , a corresponding downwards movement accompanying the final part of the return stroke of the reciprocatory movement. The web 24 of material moves at a substantially constant speed in the direction of the arrow v . Just as there are reproduced only a representative break-away pin 14 for the upper tool, only a representative break-away pin 20 for the lower tool, and only a representative section 52 for the break-away matrix 28, only a representative section 50 is shown for the web 24 of material. When this section 50 is located in the position 100 in FIG. 3, the break-away pins 14 and 20 are located at the points 100'' and 100''', whilst the section 52 of the break-away matrix 28 is at the point 100'.

As soon as the section 50 has reached the point 100, the break-away pins 14 and 20, as well as the break-away matrix 28, begin to accelerate, so that one after the other the points 101', 102', 103'....., 101'', 102'', 103'', ... , 101''', 102''', 103'''..... are reached, when the web 24 of material moves to the points 101, 102, 103..... The transition from one point to the next always takes place, moreover, within an equal time interval, so that from the record of the consecutive passing-through points in FIG. 3 it is already evident, on principle, in what manner the angular velocities w_1 and w_2 and the rate of travel of the break-away matrix change.

As it passes through the points 101'–107' the section 52 of the break-away matrix 28 is accelerated to the speed of travel v of the web of material, and at the same time moved in the direction of the arrow y towards the web 24 of material. As it passes through the point 108' the section 52 (and thus the whole break-away matrix 28) is in contact with the underside of the roll of material, in order to remain at this level until it reaches the point 118'. The rate of travel of the break-away matrix in the direction of the arrow x is equal to that of the rate of travel v only until the point 113' is reached. Subsequent to the point 113' this speed of travel is retarded and has reached nil at the point 118'. Thereafter the break-away matrix can be returned in the opposite direction to the arrow x to its starting position and in so doing lowered to the initial position in the opposite direction to the arrow y . The break-away matrix 28 thus passes between the point 100' and the point 108'

through a first section for acceleration to the speed of the web of material, and between the point 108' and the point 113' through a second section within which the speed of travel of the break-away matrix 28 is the same as the speed of travel v of the web 24 of material. During a third section between the points 113' and 118' the break-away matrix undergoes deceleration, and during a fourth section between the points 118' and 100' the break-away matrix can be returned to its initial position at such a speed that the break-away matrix is in the position 100' for registration with the next sheet length of the web when this is in the position 100.

At the same time the path of movement of the break-away matrix 28 which includes the four sections has a first phase located between the starting point 100' and the point 108', during which the break-away matrix is moved out of its spaced position towards the underside of the web of material in the direction of the arrow y . This phase of the upwards movement moreover coincides essentially with the first section during which the break-away matrix is accelerated from the rest position to the speed of travel of the web 24 of material. In the same way the path of movement of the break-away matrix includes a phase of the downwards movement away from the web of material, which coincides according to the embodiment of the invention shown in FIG. 3, essentially with the end of the fourth section.

The break-away pins 14 and 20 of the upper tool 12 and the lower tool 18 undergo, as the consecutive points 100'' – 109'' and 100''' – 109''' of the path 42 or 42' are passed, an acceleration from their rest position so that when they reach the web of material 24 at the points 109'' and 109''' in the direction of movement of the web of material they have the same speed as the latter. The two paths 42 and 42' intersect at the point 109'' or 109''' so that the working surfaces of the two break-away pins 14 and 20 grip the web of material between them. The lower break-away pin 20 penetrates at the same time an associated recess in the break-away matrix 28. The lower break-away pin 20 has reached its highest position at the point 109' so that on further movement along the path 42' it is again lowered. The upper break-away pin 14 on the other hand undergoes further lowering on its further movement along the path 42, so that the prestamped piece of material to be broken away can be pressed out of the web of material, which is possible as a result of the synchronous movement of the break-away pins 14 and 20, and that of the break-away matrix 28 with the web of material when the web of material moves on. As a result of its flexible mounting the break-away pin 20 is able to give way to the downwards movement of the upper break-away pin 14 at the point 110'' or 110'''. The amount of deflection of the lower break-away pin 20 when this happens corresponds to the length denoted b .

As the break-away pins 14 and 20 move further along their paths 42 and 42' the upper break-away pin 14 reaches its lowermost position so that the piece of material to be broken away has been dislodged from the web 24 of material by the break-away pin to the greatest possible extent. The lower break-away pin 20, since the paths 42 and 42' intersect at the points 111'' and 112'', is again sprung back to its normal position, and directly after the points 111'' and 111''' have been passed the clamping of the piece of material 54 between the two correlated break-away pins 14 and 20 is released, so that the piece of material 54 can drop out.

The lower break-away pin 20 begins at this point of time to decelerate again, while the upper break-away pin 14 is still in synchronous travel until it has reached the point 113". Here the path 42 intersects the guide plane of the web 24 of material so that the upper break-away pin 14 also can move once again independently of the web 24 of material and can thus be decelerated. As the length denoted a in FIG. 3 corresponds to the length a in FIG. 2, the displacement of the mid-points $m1'$ and $m1$ relative to one another is exactly equal to the distance of the points 109 and 111 from one another, i.e., the respective positions at which the lower and upper break-away pins 14, 20 impinge cooperatively upon the web 24 of material and clamp same, and are detached from same.

Thereafter the break-away pins 14 and 20, just as is the case with the break-away matrix 28 travel back to their starting positions 100" and 100'" in order to commence the next break-away cycle.

The break-away pins 14 and 20 thus likewise travel through a first section for acceleration from their starting position to the speed of the web of material which here is located between the points 100" and 109", and 100'", and 109'". This is followed by a second section during which the break-away pins travel synchronously with the web of material, this second section extending for the upper break-away pin between the points 109" and 113", and for the lower break-away pin between the points 109'" and 111'". During a third section which begins for the upper break-away pin at the point 113" but for the lower pin at the point 111'", and ends in each case at about the points 121" and 121'", the break-away pins are decelerated. Finally, during a fourth section, which extend between the end-points of the third section and the starting position, the break-away pins can return to their starting position.

At the same time care is taken that the upper break-away pins pass through a phase of the downward movement which nearly coincides with their first as well as a part of their second section, and a phase of the upwards movement which coincides with a part of the second section as well as a part of the third section, and the lower break-away pins in comparison pass through a phase of the upwards movement which coincides with their first section as well as a phase of the downwards movement which coincides with the second section as well as, in part, the third section.

All basic elements of the break-away device, i.e., in timed synchronism, both upper and lower tools as well as break-away matrix may therefore, be brought up against the web of material with the pre-stamped pieces of material which are to be broken away and also moved on together with the web in order to effect the break-away operation on the moving web of material, so that simple and observable conditions with respect to the guiding of the upper and lower tools as well as the break-away matrix can be ensured along the path of movement desired for the carrying out of a break-away operation on the moving web of material.

I claim:

1. A method of breaking away pre-stamped pieces of material in sheet-like webs of material, comprising moving such a web of material in the direction of its length, progressively bringing a break-away matrix up to the speed of movement of the web to make surface contact with one side of the web on attaining speed synchronism therewith, also progressively bringing up to

the speed of movement of the web pairs of members whereof one of each pair is at each side of the web to grip therebetween on attaining speed synchronism with the web pieces of material to be broken away from the web, and breaking away the so-gripped pieces of material against the support of the matrix.

2. A device in a stamping machine for breaking away pre-stamped pieces of material in sheet-like webs of material in a break-away zone of the machine, said device comprising means for progressing such a web along a plane in the direction of its length, first and second carriers mounted one above and one below said plane in the frame of the machine at the break-away zone for movement towards and away from said plane, networks of rigidly-mounted break-away pins which are mirror images of one another mounted in said first and second carriers with the axes of the break-away pins normal to said plane and the lower break-away pins resiliently displaceable in the directions of their lengths, a third carrier supported in said frame below said plane, a matrix mounted on said third carrier and having through-openings each co-axial with an upper and a lower break-away pin, and means for guiding the first, second and third carriers each along a path of movement in relation to the movement of the web with appropriate correlation of the break-away pins and the through-openings in the break-away matrix with the pieces of material to be broken away such that in a first section the three carriers are accelerated from starting positions to the speed of the web, in a second section at least between the start and finish of the break-away operation the three carriers move synchronously with the web, in a third section the three carriers are decelerated, and in a fourth section the three carriers are returned to their starting positions, the path of movement of the first carrier including a phase of downwards movement towards said plane and substantially coincident with its first and second sections and a phase of upwards movement away from said plane and substantially coincident with its third section, the path of movement of the second carrier including a phase of upwards movement towards said plane and substantially coincident with its first section, and a phase of downwards movement away from said plane and substantially coincident with its second and third sections, and the path of movement of the third carrier including a phase of upwards movement towards said plane until the matrix is applied against the web, said phase being substantially coincident with its first section, and a phase of downwards movement away from the web and falling into the end of its fourth section.

3. A device as set forth in claim 2, in which the second section of the third carrier is of greater duration than the second section of both the upper and lower carriers.

4. A device as set forth in claim 3, in which eccentric drives mount the first and second carriers in each case ensuring their guidance parallel to said plane with the eccentricity in conformity with the movement towards and away from said plane, and the first carrier is offset in relation to the second carrier by a distance, in the direction of travel of the web of material, corresponding to the movement section lying between the beginning and end of the break-away operation.

5. A device as set forth in claim 4, in which carriages on crankpins of crankshafts located at the ends of the carriages mount the first and second carriers, and the

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mid-points of the crankshaft and of the crankpin in each case are spaced from one another by a distance corresponding to the radius of the paths of travel of the first and second carriages, and the mid-points of the crankshafts supporting the first carriage — in relation to the direction of movement of the web are spaced behind the mid-points of the crankshafts supporting the second carrier.

6. A device as set forth in claim 5, in which the dis-

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tance between the mid-points of the crankshafts of the first and second carriages in relation to the direction of movement of the web is the same as the distance between a point at which associated upper and lower break-away pins engage the web and a point at which the lower break-away pin is again detached from the associated upper break-away pin.

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