July 8, 1958 C. L. GRIFFITH 2,841,818

MEAT-PERFORATING APPARATUS

Filed Aug. 25, 1955 4 Sheets-Sheet 1

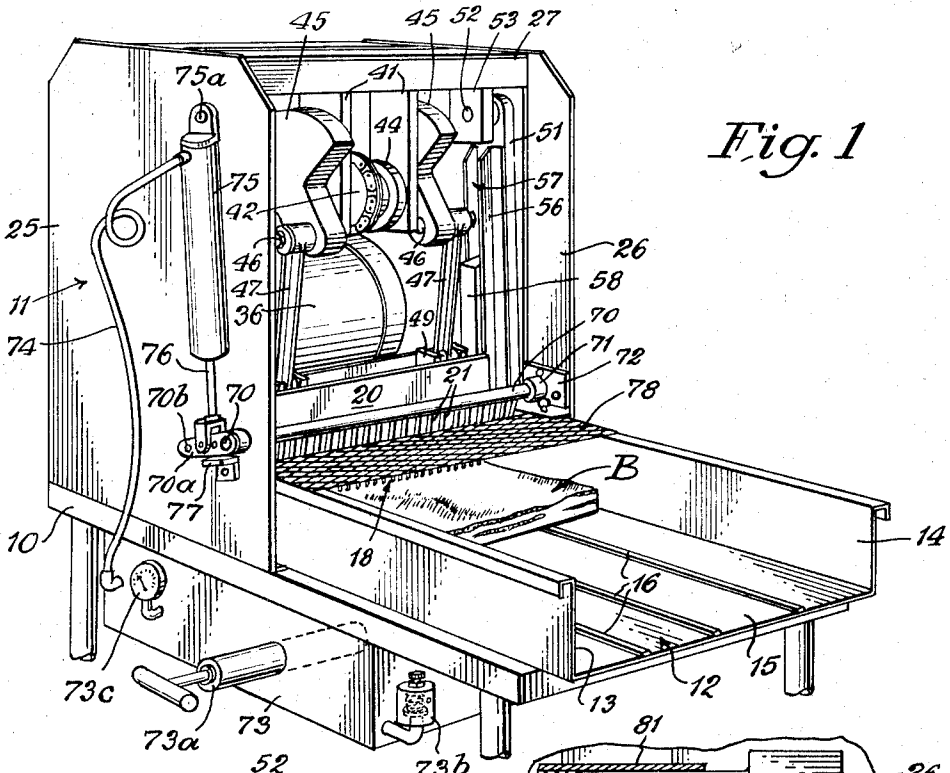


Fig. 1

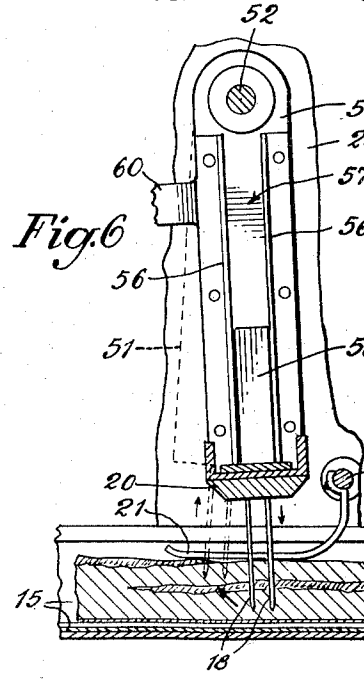


Fig. 6

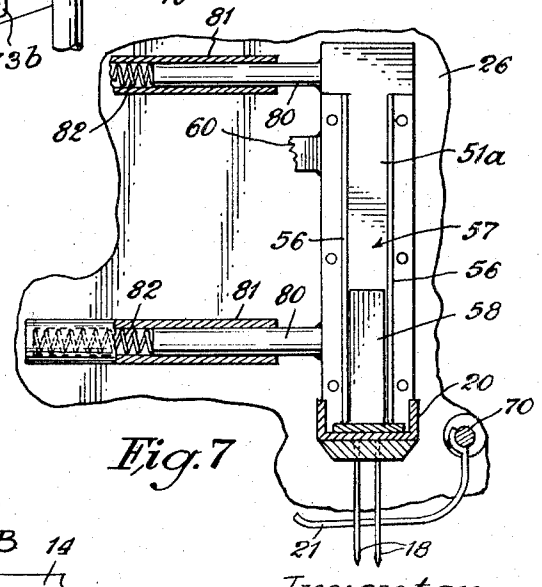


Fig. 7

Inventor
Carroll L. Griffith
by W. Bartlett Jones
Attorney

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Fig. 2

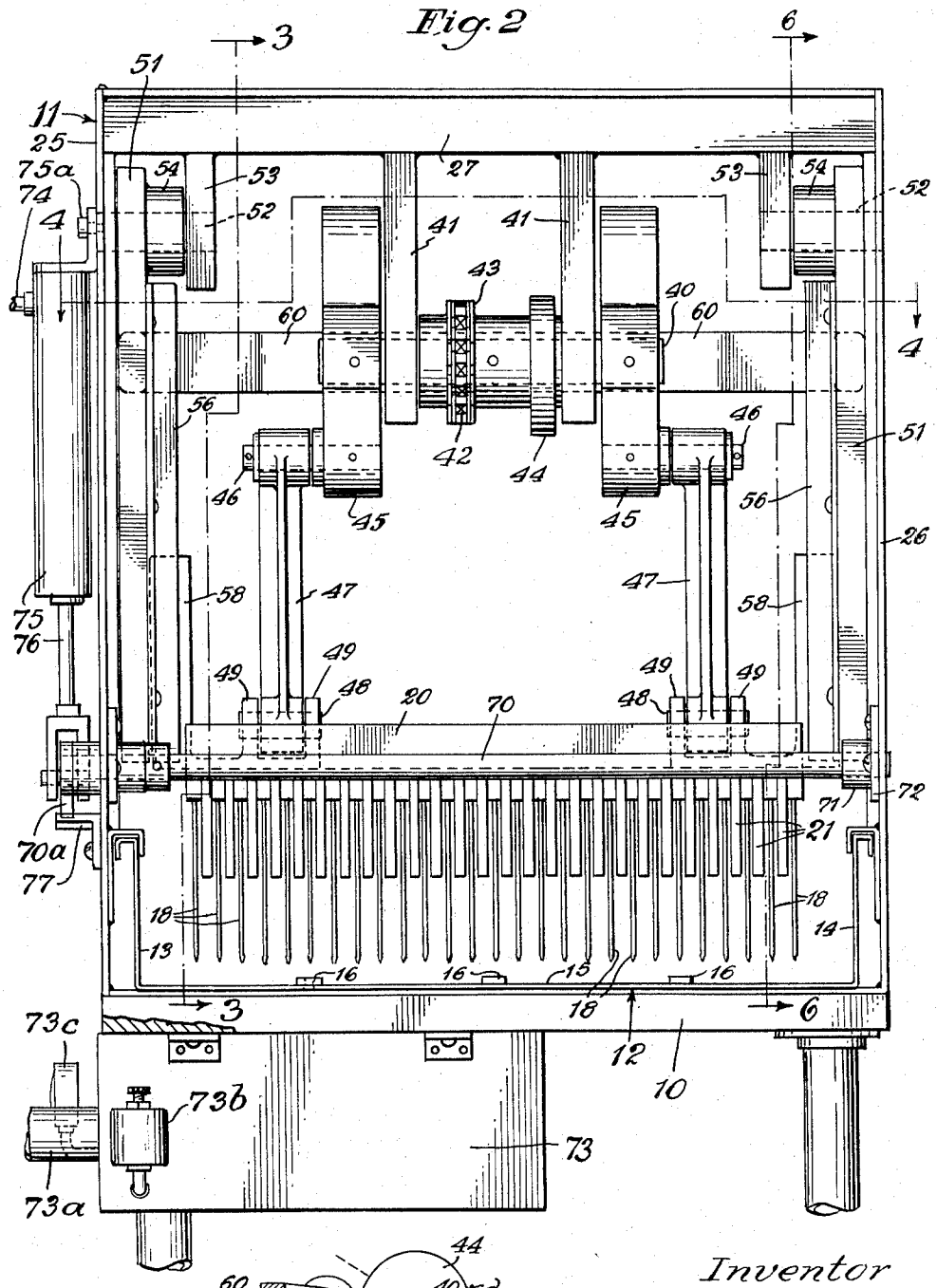
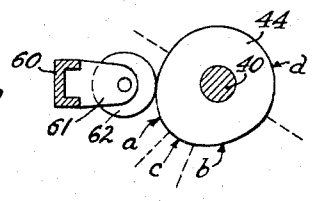


Fig. 8



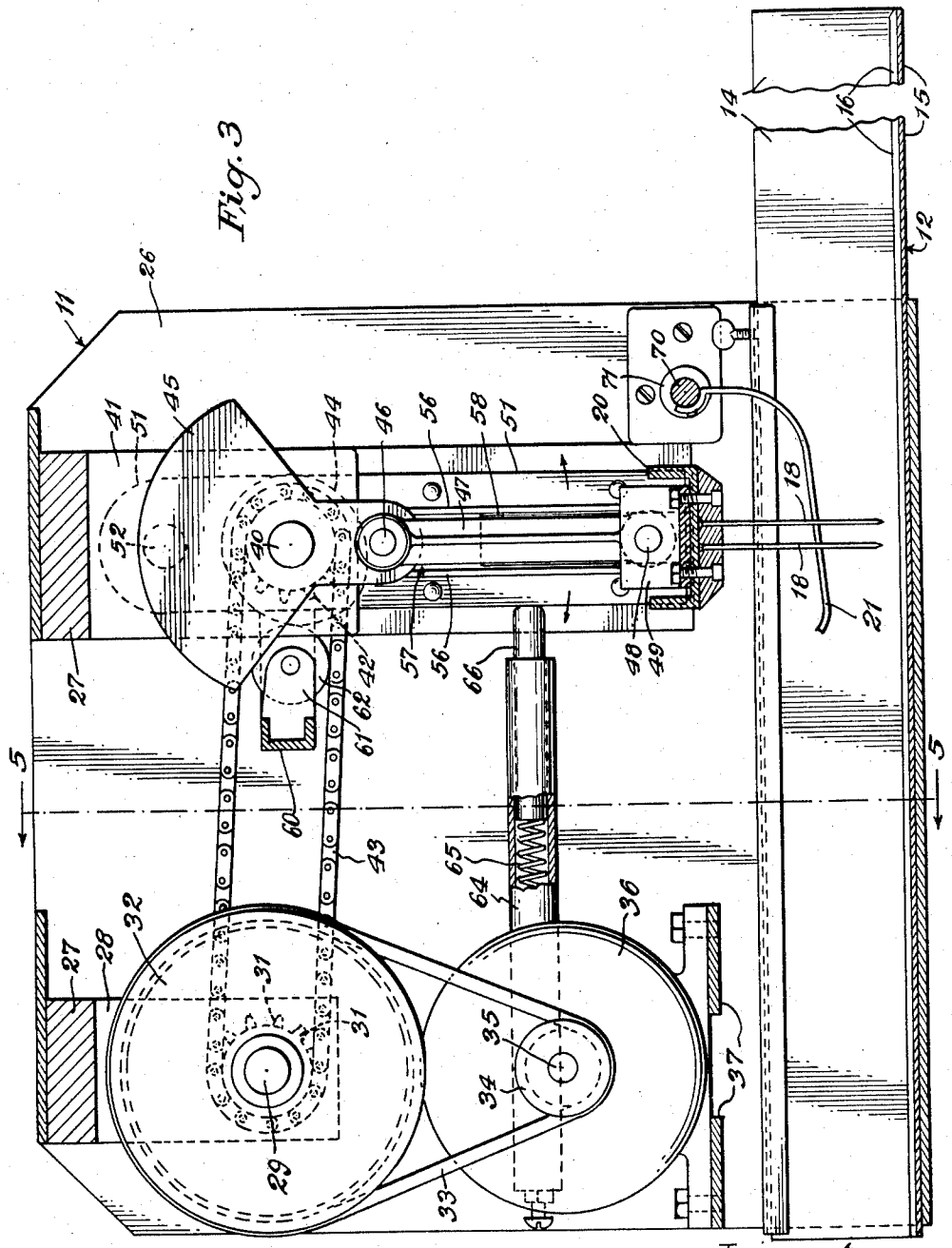
Inventor
Carroll L. Griffith
by W. Bartlett Jones,
Attorney

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MEAT-PERFORATING APPARATUS

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Fig. 3



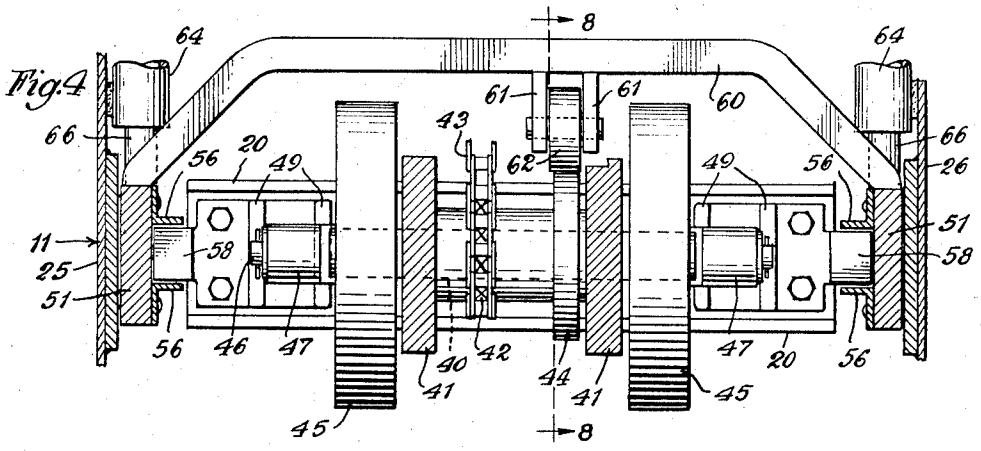
Inventor
Carroll L. Griffith
by W. Bartlett Jones,
Attorney

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MEAT-PERFORATING APPARATUS

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Fig. 4



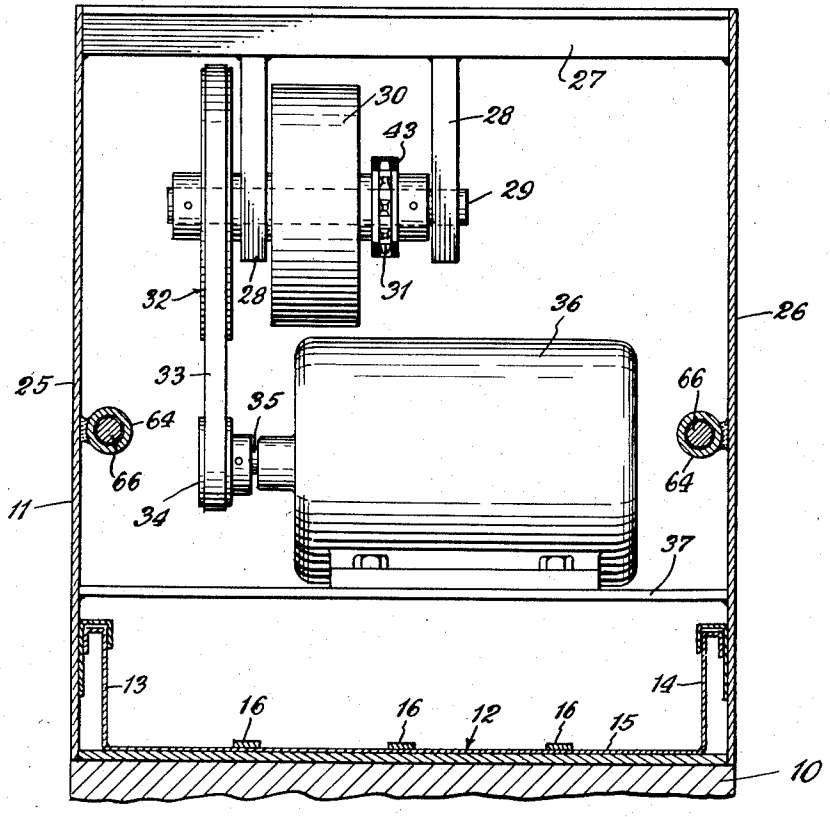


Fig. 5

Inventor
Carroll L. Griffith
By W. Bartlett Jones
Attorney

United States Patent Office 2,841,818
Patented July 8, 1958

2,841,818

MEAT-PERFORATING APPARATUS

Carroll L. Griffith, Chicago, Ill., assignor to The Griffith Laboratories, Inc., Chicago, Ill., a corporation of Illinois

Application August 25, 1955, Serial No. 530,558

10 Claims. (Cl. 17—25)

The present invention relates generally to apparatus for meat processing, and in particular to improvements in an apparatus for perforating meat, disclosed in Patent No. 2,816,320 of December 17, 1957.

The apparatus is adapted for well-known methods of tenderizing meats by continuous insertion and withdrawing of suitable cutting tools for the purpose, but it is especially designed for forming a pattern of artificial pores in meat for use in meat-treating processes. It has special reference to processes of curing pork bellies on a large scale in packing plants. In such operations, a great number of raw chilled pork bellies are fed to the machine, perforated in and by the machine which automatically advances the belly through the machine, and then the resulting perforated pieces having newly formed open pores are suitably processed by treatment utilizing the pores as channels for entry of curing or other treating material.

The apparatus is designed as a small compact apparatus which may be easily moved from one bench to another, which is readily cleaned to maintain it in sanitary condition, which may be operated by a single individual, and which acts correspondingly fast for such purpose.

In general, the apparatus has a bank of perforating pins which reciprocates vertically to penetrate a belly and to withdraw therefrom. The bank has a simultaneous horizontally moving cycle with short periods of rest at the extremes. During one extreme, the pins enter a stationary belly, then as they penetrate deeper the pins advance the belly by horizontal motion to the other extreme, meanwhile starting to move upwardly. At the second period of rest, the belly ceases to advance, the pins leave the belly and return above the belly to the station for initial penetration.

The upward movement of the pins after maximum penetration tends to lift the belly with them as a result of friction of a pin walls against the chilled interior of the belly. Lifting is permitted by the apparatus to minimize friction of the moving belly on the bed plate. To cause separation of the pins and the belly at a point in the cycle so that the pins may return to said initial station, stripper means are imposed in the path of the rising belly.

The machine of said Brown application as above described has certain deficiencies in general operation in a packing plant where bellies of various sizes and conditions are successively passed through the machine.

Bellies vary in thickness from belly to belly depending upon the size of the hog. Also, each belly varies in thickness and in width. These factors lead to variable friction.

The uplift of a belly by reason of the friction of the pins is therefore variable. The friction depends in part upon the thickness of the belly, its temperature, and its content of lean and fat in the region holding the pins. The uplift also depends upon the effective weight of the belly as a whole and its distribution. The effective weight varies from the leading end of the belly going through the machine to the middle and then to the trailing end. These accumulating effects sometimes result in unequal spacing of the holes. Gravity and pin friction work against each other. The present invention aims to minimize these difficulties.

It is the general object of the present invention to supplement the force of gravity on the belly during such uplift.

It is also an object of the invention to increase the force opposing friction of the pins to a higher value such that the changing effective weight of the belly itself as it passes through the machine becomes a smaller portion of the said opposing force.

It is a particular object of the invention to provide movable means exerting a substantially constant mechanical pressure on the top of the belly to oppose the uplifting force of friction between the pins and the belly in withdrawing the pins.

It is a particular object to provide the constant mechanical pressure by means of compressed air at a constant predetermined but variable pressure.

Various other and ancillary objects and advantages of the invention will become apparent from the following description and explanation of the invention as set forth in connection with the accompanying drawings in which:

Fig. 1 is a pictorial rear view of the apparatus.

Fig. 2 is an enlarged rear elevation of the apparatus as seen in Fig. 1.

Fig. 3 is a vertical cross section of the apparatus taken on the line 3—3 of Fig. 2.

Fig. 4 is a partial horizontal section of the rear portion of the machine taken on the line 4—4 of Fig. 2.

Fig. 5 is a vertical cross section looking toward the forward end taken on line 5—5 of Fig. 3.

Fig. 6 is a detailed reduced view of the guiding means taken on the line 6—6 of Fig. 2.

Fig. 7 is a modification showing a substitute for the guiding means of Fig. 6.

Fig. 8 is a detailed view of the cam taken on line 8—8 of Fig. 4 to show its camming surfaces.

The apparatus is designed particularly for pork bellies, but it may be modified for other shapes of meat, or other kinds of meat suitably shaped may be perforated by the machine shown in the drawings. The following description of the machine and its operation is directed to the use of pork bellies, with the intention that the invention is not thereby limited to such pieces.

The curing of pork bellies should be uniform, and it is therefore important that the holes in the belly be located in a uniform pattern when the holes function in a curing process.

When the meat piece is chilled, its plasticity is so much less than when it is at a more elevated temperature that a hole or pore may be made of such size that it does not close while such chill temperature is maintained, and yet the hole may be of such size that it will close in later processing. For example, when the meat piece is a chilled pork belly such pores may be made at a multiplicity of locations for use in a curing operation. A pork belly or other piece of meat so made artificially porous may be immersed in brine for curing, or it may be spread with dry water-soluble meat processing material in the conventional manner of "dry salt cures." In so doing, and especially with pork bellies, the juices of the meat piece readily dissolve the salt or other components so applied forming a solution which enters the pores and diffuses therefrom into the meat piece. Such a salt-curing process is well known for pork bellies and other meat pieces. In the case of pork bellies, the pores so formed preferably terminate within the belly and inwardly from one face which face is preferably one re-

taining the skin, so that in curing the bellies in a packing establishment they may be stacked vertically, each belly being covered with that amount of curing composition needed for its own cure.

To maintain a standardized cure in the case of pork bellies, the bellies should be similarly perforated, that is, the pattern of holes should be standardized in depth and spacing. The apparatus of the present invention operates automatically to effect a standard pattern. The apparatus is so organized that only one operator is needed for the machine. He merely feeds a pork belly to the machine which then advances it through the machine to make room for receipt of a following piece. For this purpose, the machine is power operated and runs in repeating cycles with or without a meat piece undergoing treatment.

The apparatus is represented pictorially in Fig. 1 as a unit mounted on a suitable carriage **10**. It has a framework or housing **11** and carried thereby a generally horizontal bed plate **12** in the form of a removable channel with side walls **13** and **14**, and bottom **15** on which are mounted bearing or guiding ribs **16** to lessen sliding friction. The bed plate is easily removable like a drawer for cleaning. In Fig. 1 may be seen a bank of tools, which are preferably pointed cylindrical pins **18** shown entered into a pork belly B undergoing perforation. The bank of pins reciprocates in a generally vertical direction in repeating cycles and also in a generally horizontal direction in concurrent cycles. The two cyclical movements are so related that the pins enter the belly B at the rear of the machine while the bank is in its rearmost horizontal position. Then the bank moves forward while the pins are in the belly, thereby to advance the same. Then the pins withdraw and move back to rearmost position while out of the belly. In withdrawing the pins, the frictional engagement is sufficiently great, and desirably so, to lift the belly from the bed plate. The apparatus is designed to take advantage of such lifting. Lifting lessens the frictional sliding while advancing the piece of meat. Lifting maintains the pins more deeply inserted in the meat piece while the pins are moving in the upward stroke of the cycle of vertical reciprocation, thus tending less to bend the pins. Stripper means is provided to oppose the uplifting force with a substantially constant pressure and is positioned to cause dropping of the meat piece before the pins start their rearward movement in the cycle of horizontal reciprocation.

The actions above referred to are illustrated in Fig. 6 (below Fig. 1) wherein the pins **18** are indicated as mounted in a crosshead **20**. In full-line showing the pins are in the rearmost and downmost position, and in dotted-line showing they are in foremost position, but only partly raised to uppermost position. Between these extremes of horizontal position, the pins advance the meat and lift it toward stripper means **21** which holds the meat piece while the pins are withdrawn completely. Then the crosshead moves rearwardly again to its arrested rearmost position and the crosshead moves down in penetrating action to the position shown.

The crosshead **20** is mounted for substantially vertical reciprocation with relation to suitable guide means and the latter is arranged to move in a cycle for imparting to the crosshead its horizontal movements. The preferred construction is a horizontally swinging guide means coupled with cam means to control its movements and positions. For the vertical reciprocation of the crosshead, eccentric means is preferred, and thus the eccentric means and the cam means may be mounted on a single power shaft to relate the two cycles as desired.

The housing **11** comprises two vertical side walls **25** and **26** with connecting cross bars **27** at the top. In brackets **28** suspended from forward cross bar **27** is an idler shaft **29** (Fig. 5) bearing a fly wheel **30**, a sprocket **31** and a pulley **32** over which runs a belt **33** from a pulley **34** on shaft **35** of motor **36** mounted on a housing shelf **37**. Across the rear and midway between side walls **25** and **26** is a crank shaft **40** (Figs. 2 and 4) bearing in brackets **41** depending from rear cross bar **27**. Rigid on shaft **40** are sprocket **42** connected by chain **43** to forward sprocket **31**, a cam **44**, and at the shaft ends outside of brackets **41** two counter-balanced cranks **45**. The cranks **45** have crank pins **46** bearing connecting rods **47** which also pivot on bearing pins **48** mounted between lugs **49** carried by the crosshead **20**.

Guide means for crosshead **20** is arranged to move the crosshead in a limited horizontal cycle of movement. Because a limited departure from perpendicular penetration and withdrawal of pins with respect to a pork belly is permissible, owing to the flexibility of the belly even when chilled, a simple swinging guide means movable in a small arc is provided. Just within the inner faces of each side wall **25** and **26** is a depending arm **51** of flat stock pivoted on co-axial pins **52** mounted in the adjacent side wall and in depending lug **53** alongside a spacing ring **54**. The face of each arm **51** has two spaced angle irons **56** (see Figs. 1 and 4) secured to it forming between them a channel **57** in which slides a block **58** secured to and projecting upwardly from the crosshead **20**. The two swinging bars **51** are interconnected and integrated as a guide unit by a forwardly extending yoke **60** (see Fig. 4) extending horizontally between the two stretches of chain **43** (Fig. 3) and at a location facing cam **44**. Yoke **60** has bracket lugs **61** in which bears a cam-riding wheel **62** resting on the forward face of cam **44**. The cam and its rider **62** control the position of the guiding means in conjunction with spring means normally urging the guide means to its rearmost position. Welded to each side wall is a hollow cylinder **64** aimed at its respective swinging arm **51**. Each cylinder **64** contains within it a compression spring **65** and a plunger **66** forced by the spring against the side edge of arm **51**. The cam **44** may vary greatly in its contour to regulate the movements and control the position of the movable guide means. Preferably it consists of two opposite concentric circular portions of the periphery with different diameters against each of which the cam rider remains stationary during a portion of the revolution of power shaft **40**, so that the guiding means is arrested at each of its extreme horizontal positions. Thus, the cam has non-radial connecting portions of the periphery which act upon the cam rider **62** to move the guiding means forward with a power push in advancing the meat during penetration, and in allowing the spring **65** to move the guiding means to rearmost position after release of the meat by the stripper means.

Fig. 8 shows the cam **44** with its eccentric portions designated *a* for the forward stroke, and *b* for the rearward stroke, and with the intermediate concentric inactive portions designated *c* and *d*. The eccentric portion *a* moves the tools, and thereby the meat, with power in the forward stroke, but quickly in a small fraction of the cycle time. The circular portion *c*, which may vary in length upwardly from zero, predetermines the time of rest from mere reversal to halting at the forward extreme position. The eccentric portion *b* permits the springs **82** to move the guide means to rearward position while the tools are out of the meat and are completing the cycle for a new penetration. The extended circular portion *d* of the cam holds the guide means at the rearmost position while the tools penetrate substantially to lowermost position, and then they begin to withdraw as they move the meat forward again by eccentric cam portion *a*. Accordingly, the cam section *d*, as shown, results in the meat piece resting on the bed plate for more than half the time in the cycle, being thus at rest while the tools move only to penetrate and while the swinging guide means rests in its rearmost position.

The present invention is directed primarily to the stripper means as shown in Fig. 6. It consists of a plu-

rality of fingers 21 which lie between pins 18 and means to press the fingers onto the meat to resist uplift force. To avoid forming parallel ridges in the meat, the fingers are flat and numerous. The fingers are rigidly mounted in a shaft 70 which has one bearing 71 in a plate 72 secured to side wall 26 and a bearing by projection through side wall 25 for means to exert a rotary force on said shaft 70 whereby to press the fingers 21 on the belly.

In providing constant pressure to the movable stripping fingers 21, the action should be fast. Therefore, compressed air is the preferred source of pressure. Because there is no functional loss of air and because leakage may be minimized by mechanical construction, a reservoir of compressed air is provided as a part of the apparatus in order to free it from air connections and to preserve its mobility. Numeral 73 represents an air tank situated below the bed plate 12. It has a hand pump 73a by which the operator may create air pressure up to the limit of a regulatable pop valve 73b. This may be set variously for a pressure in the range from 4 to 6 lbs. per square inch gauge, of course, depending upon the actual pressure desired, which is indicated in a gauge 73c. An air conduit 74 leads from the tank 73 to a cylinder 75 pivoted at 75a to the side wall 25. Pressure in the cylinder 75 acts upon a piston of which the piston rod 76 is connected to a crank arm 70a on shaft 70. A series of holes 70b in said crank arm permits shifting the leverage to vary the constant pressure on the belly by means other than the supply of air in tank 73. This permits adjustments where the prevailing size or temperature of the bellies may vary from plant to plant. The constant pressure in cylinder 75 forces the crank arm 70a onto a fixed stop 77 which predetermines the lowermost position of the fingers 21 within the apparatus when no belly is present.

In Fig. 1 an open latticework plate 78 is shown rearwardly of the shaft 70 merely as a safety device to prevent the operator inadvertently getting his hands into the space for receiving the piece of meat to be perforated.

Fig. 7 shows a more ideal construction for the guiding means so arranged that the entire guiding means remains vertical, to keep the pins 18 vertical, and moves only in truly horizontal cycle of reciprocation. Rather than mounting the arms 51 for swinging through a small arc, similar arms 51a each have two integral horizontal arms extending forward as plungers 80 entering horizontal cylinder 81 containing compression springs 82.

In operation the motor 36 effects constant reciprocation of the crosshead 20 in a vertical direction by the eccentric structure of the cranks, while at the same time the cam 44 on the power shaft 40 causes the guiding means to move between its two extreme horizontal positions of rest. As this is going on, a piece of meat, such as a pork belly, is inserted into the space between the bed plate 12 and the protective latticework plate 78 until the pins 18 enter it in a substantially vertical direction. When the pins 18 are substantially fully inserted, the crosshead moves forwardly carrying the piece of meat with it, with the stripping fingers 21 pressing on the top. At the same time the pins rise to a limited extent to the time when the crosshead is in its forward horizontal position of rest, and during this rise the friction of the pins in the belly lifts the belly against the constant pressure of the stripper fingers 21. At said last-mentioned position of rest, the pins have advanced and lifted the belly to a limiting position of the stripping fingers 21, where it is held against lifting as the pins completely withdraw. The downward force of the fingers 21 plus the weight of the belly overcome the lessening friction of the pins as they rise and as a result the belly drops before the pins complete the upward stroke. When the pins are thus free of the piece of meat, the cam 44 permits the spring 65 to urge the guiding means back to rearmost position to repeat the cycle.

It is noted that two rows of pins 18 are shown. These are spaced apart a distance in agreement with the extent of forward motion in each cycle so that the pattern of holes formed is regular, and preferably such that the holes are spaced apart the same amount across the belly as along the belly. However, this is a matter not material to the final result.

The pieces of meat are suitably removed from the machine and cured, such acts forming no part of the present invention.

Various changes and modifications in structure may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim:

1. Apparatus comprising a frame, a generally horizontal bed plate fixed relative to the frame on which slidingly to support a piece of meat, a crosshead mounted in said frame for reciprocation above said bed plate and generally perpendicular thereto, meat-piercing tools carried by said crosshead in a bank extending across said bed plate and positioned to enter a piece of meat on said bed plate, a rotary operating shaft mounted in said frame, eccentric means on said shaft operatively connected to said crosshead for reciprocating it in a direction generally perpendicular to said bed plate, swinging guide means for said crosshead pivoted on a horizontal axis to said frame adjacent its upper end, cam means on said shaft operatively associated with said guide means to effect horizontal swing of said guide means on its pivotal axis, said cam means having a first portion providing no camming action in a first extreme of the arc of swing of the guide means at which time the eccentric means effects a downward movement of the crosshead with penetration of the meat, a second portion operable to cam the guide means forward to the second extreme in the arc of swing while the eccentric means lifts the crosshead in withdrawing the tools from the meat and while moving the meat in the forward direction by the tools, a third portion providing no camming action for limiting the forward movement of the guide means and of the meat moved by the tools, and a fourth portion operable to cam the guide means to its rearmost horizontal position while the eccentric means moves the tools from withdrawing position to penetrating position, stripper means carried by said frame movable into a position which is above the normal level of the meat on said bed plate and below the lower ends of the tools in their uppermost position, whereby to free the meat from the tools and permit the tools to move above the meat during return of the crosshead from its advancing movement, and movable constant pressure means connected to said stripper means for moving it into the path of an entering piece and force it onto the top face of a passing piece, whereby to limit the rise of the piece in withdrawing the pins.

2. The apparatus of claim 1 in which the constant pressure means comprises a piston and cylinder arranged under air pressure with the piston connected to move said stripper means, and a supply of air at constant pressure connected to said cylinder.

3. Apparatus comprising a frame, a generally horizontal bed plate fixed relative to the frame on which slidingly to support a piece of meat, a crosshead mounted in said frame for reciprocation above said bed plate and generally perpendicular thereto, meat-piercing tools carried by said crosshead in a bank extending across said bed plate and positioned to enter a piece of meat on said bed plate, a rotary operating shaft mounted in said frame, eccentric means on said shaft operatively connected to said crosshead for reciprocating it in a direction generally perpendicular to said bed plate, cyclically movable guide means for said crosshead mounted in said frame and arranged for substantially horizontal movement of said guide means and crosshead, cam means on said

shaft operatively associated with said guide means to effect said horizontal movement of said guide means and crosshead, said cam means having a first portion providing no camming action in a first extreme horizontal position of the guide means at which time the eccentric means effects a downward movement of the crosshead with penetration of the meat, a second portion operable to cam the guide means forward to the second extreme horizontal position while the eccentric means lifts the crosshead in withdrawing the tools from the meat and while moving the meat in the forward direction by the tools, a third portion providing no camming action for limiting the forward movement of the guide means and of the meat moved by the tools, and a fourth portion operable to cam the guide means to its rearmost horizontal position while the eccentric means moves the crosshead and the tools from withdrawing position to penetrating position, stripper means carried by said frame movable into a position which is above the normal level of the meat on said bed plate and below the lower ends of the tools in their uppermost position, whereby to free the meat from the tools and permit the tools to move above the meat during return of the crosshead from its advancing movement, and movable constant pressure means connected to said stripper means for moving it into the path of an entering piece and force it onto the top face of a passing piece, whereby to limit the rise of the piece in withdrawing the pins.

4. The apparatus of claim 3 in which the constant pressure means comprises a piston and cylinder arranged under air pressure with the piston connected to move said stripper means, and a supply of air at constant pressure connected to said cylinder.

5. Meat perforating means comprising in combination a framework, a generally horizontal bed carried by said framework on which slidingly to advance a piece of meat, a crosshead mounted within said framework and movable over said bed plate in a substantially vertical cycle of reciprocation and in a substantially horizontal cycle of reciprocation, a bank of substantially vertical meat-penetrating tools carried by said crosshead crosswise of said bed plate, first means in said framework to reciprocate said crosshead vertically in repeating cycles, second means operatively associated with said first means to move said crosshead horizontally in concurrent repeating cycles of shorter duration than that of the vertical cycle, said second means being arranged to effect a period of rest at at least one of the horizontal extremes of the shorter-line cycle, said first means being arranged to effect a down-stroke of the crosshead for penetration of meat by said tools during said one period of rest in the horizontal cycle and to make an incomplete up-stroke while said second means effects movement of the crosshead toward the second horizontal extreme, whereby said partial up-stroke by friction of the tools tends to lift a piece of penetrated meat and move it horizontally, stripper means carried by said frame movable into a position which is above the normal level of the meat on said bed plate and below the lower ends of the tools in their uppermost position, whereby to free the meat from the tools and permit the tools to move above the meat during return of the crosshead from its advancing movement, and movable constant pressure means connected to said stripper means for moving it into the path of an entering piece and force it onto the top face of a passing piece, whereby to limit the rise of the piece in withdrawing the pins.

6. The apparatus of claim 5 in which the constant pressure means comprises a piston and cylinder arranged under air pressure with the piston connected to move said stripper means, and a supply of air at constant pressure connected to cylinder.

7. Meat perforating means comprising in combination a framework, a generally horizontal bed carried by said framework on which slidingly to advance a piece of meat, a crosshead mounted within said framework and movable over said bed plate in a substantial vertical cycle of reciprocation and in a substantially horizontal cycle of reciprocation, a bank of substantially vertical meat-penetrating tools carried by said crosshead crosswise of said bed plate, a first means in said framework to reciprocate said crosshead vertically in repeating cycles, second means operatively associated with said first means to move said crosshead substantially horizontally in concurrent repeating cycles, said second means being operable to hold said crosshead at one horizontal extreme while said first means effects a down-stroke and penetration of the meat on said bed plate, and said second means being operable to move said crosshead to the second extreme horizontal position while said first means is effecting the up-stroke of the crosshead and withdrawal of the tools from the meat, stripper means carried by said frame movable into a position which is above the normal level of the meat on said bed plate and below the lower ends of the tools in their uppermost position, whereby to free the meat from the tools and permit the tools to move above the meat during return of the crosshead from its advancing movement, and movable constant pressure means connected to said stripper means for moving it into the path of an entering piece and force it onto the top face of a passing piece, whereby to limit the rise of the piece in withdrawing the pins.

8. The apparatus of claim 7 in which the constant pressure means comprises a piston and cylinder arranged under air pressure with the piston connected to move said stripper means, and a supply of air at constant pressure connected to said cylinder.

9. Apparatus comprising a frame, a generally horizontal bed plate fixed relative to the frame on which slidingly to support a piece of meat, a crosshead mounted in said frame for reciprocation above said bed plate and generally perpendicular thereto and for simultaneous reciprocation substantially horizontally, meat-piercing tools carried by said crosshead in a bank extending across said bed plate and positioned to enter a piece of meat on said bed plate, power means in said frame operatively associated with said crosshead to reciprocate it substantially vertically in repeating cycles, rotary cam means connected with said power means and arranged to move and control the position of said crosshead in its horizontal reciprocation, said cam having a cycle of rotation coincident with the cycle of vertical reciprocation of said crosshead, said cam having a non-camming portion operable to hold said crosshead stationary at one horizontal extreme while said crosshead is uppermost and moves downwardly and said tools penetrate a piece of meat on said bed plate, said cam having a following camming portion operable to move said crosshead to its second extreme horizontal position during only the initial portion of the up-stroke of said crosshead, said cam having a following non-camming portion operable to hold the crosshead in said second extreme position during a following portion of the up-stroke of the crosshead and until the meat is stripped from the tools by the below-mentioned stripping means, and said cam having a following and closing camming portion operable to move the crosshead from said second to said first extreme position while the ends of said tools are above the top of a piece of meat resting on said bed plate to be pierced by the next downstroke of the crosshead, stripper means carried by said frame movable into a position which is above the normal level of the meat on said bed plate and below the lower ends of the tools in their uppermost position, whereby to free the meat from the tools and permit the tools to move above the meat during return of the crosshead from its advancing movement, and

movable constant pressure means connected to said stripper means for moving it into the path of an entering piece and force it onto the top face of a passing piece, whereby to limit the rise of the piece in withdrawing the pins.

10. The apparatus of claim 9 in which the constant pressure means comprises a piston and cylinder arranged under air pressure with the piston connected to move said stripper means, and a supply of air at constant pressure connected to said cylinder.

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