

The invention relates to a process and a hydraulic feed device for cutting an extrusion product, preferably a sliced extrusion product, which is pulsed forward in the direction of its longitudinal axis. Between two feed pulses, a cutting element, which rotates around an axis in parallel with the longitudinal axis, cuts a respective slice off an extrusion product. At least for the duration of the cutting process, a then newly developing end surface of the extrusion product is substantially covered by a side surface of the knife. This prior art is known from the DE-A-3 606 979.

Conventional processes of cutting a sliced extrusion product or similar products require a cutting element, for example a knife with a spiral cutting edge, which with each complete rotation increasingly enters at a rotary angle of approximately up to 270° into the cross-section of the extrusion until a then newly developing end surface of the extrusion product is substantially covered by a side surface of the knife, in which respect the knife moves outside the extrusion cross-section at the remaining rotary angle of up to 90° so as to complete the rotation. In the course of the last mentioned movement, the extrusion is unimpededly pushed forward by the amount of thickness of one slice, so that the next slice is cut off in the same manner in the following rotation.

In this known process, the extrusion feed has to be pulsed, as, depending on the characteristics of the extrusions, a continuous feed would divert the knife during the cutting process from the desired cutting plane, which is oriented perpendicularly to the longitudinal axis of the extrusion, and could even

twist the knife beyond its limit of elasticity, which would furthermore produce slices of very imprecise geometry.

Pulsed feed of the extrusion product is absolutely essential due to the aforescribed conditions, in particular with respect to relatively rigid or brittle products, for example cut extrusions which have to be processed in a frozen state. Therefore, conventional processes operate without exception with pulsed feed devices for the extrusion product, which require elaborate controls by means of which, for example, a hydraulic feed cylinder can be loaded with oil, wherein the conveying volume per time unit and the oil pressure have to be continuously changed. A control of this time is not only structurally elaborate and maintenance sensitive, but also causes loss of energy after each feed pulse, which energy is to be produced for operating a conveyor pump but which can no longer be utilized for the feed process.

It is an object of the invention to further develop a process of the initially described type so that the use of a control which is elaborate in its structure and operation can be dispensed with whilst still ensuring an exactly defined pulsed feed of the extrusion product.

The object is achieved by means of a device of the type described in the concept of claim 1, according to the invention comprising the features contained in the characterising part.

Due to the inventive limitation of the feed pressure between an adjustable maximum and minimum value, in that for example continuously conveyed oil, on arriving at a maximum value, is ducted into a hydraulic accumulator which increases in size due to the maximum

pressure, and on arriving at a minimum pressure is removed from the hydraulic accumulator which reduces in size, the conveyor pump can be operated continuously for loading the feed unit. The oil volume required for a feed pulse is evenly conveyed over the entire work cycle of a cutting operation from one feed pulse to another, so that the accumulator buffers the volume portion which is conveyed by the pump during two successive feed pulses of the extrusion product, although the feed unit does not carry out any movement at that time. No energy is lost, with the exception of usual degrees of effectiveness, in particular due to friction, as the output of the pump is at times used directly for feed operations and at times for loading the accumulator, and is thus also available, though indirectly, for feed operations.

Although different feed devices appear to be suitable for carrying out the inventive process, in which respect accumulators are feasible, for example in the form of spring and similar tensional components, a hydraulic feed device comprising a cylinder-piston unit, which is loaded by a pump via a pipe having a non-return valve, is recommended.

In order that the cutting operation can be carried out by a feed device of this type, it is suggested according to the invention to connect a hydraulic accumulator to the pipe between the cylinder-piston unit and the non-return valve.

The inventive feed device thus distinguishes itself by its extremely simple structure, which permits to reliably perform all characteristic features of the inventive process.

In one embodiment of the inventive device, the hydraulic accumulator is divided by an elastically

deformable separating wall into two chambers, of which one is connected to the pipe connecting to the cylinder-piston unit.

The deformation activity of the separating wall, which is a result of a temporary excess in the volume of oil which is pumped on by the pump during standstill of the feed device, releases it due to its reset capability as soon as a feed movement of the extrusion product has to be made in the next cutting cycle. When a newly established end surface of the extrusion product is released by the knife, then the hydraulic pressure loading the cylinder-piston unit is sufficient for initiating a feed movement of the extrusion product, as the pump is active during this time. And yet, the excess pressure in the system would drop too much due to the spontaneous release of the extrusion product, were it not that the reformation tendency of the separating wall of the hydraulic accumulator would limit the reduction of the excess pressure.

In order to adapt the force by which the feed device pulsedly displaces an extrusion product for cutting to suit specified conditions, which may be the result, for example, of greater or smaller deformability of the extrusion product or of frictional forces to be overcome during a displacement and the like, one embodiment of the invention provides that the separating wall of the hydraulic accumulator is fitted with devices which allow the return force to be adjusted. For example, devices of this type can be control element by which the deformability of the separating wall of the hydraulic accumulator can be prevented or restricted over surface portions of different sizes.

The drawing illustrates a hydraulic plan for an exemplary embodiment of a feed device for carrying out the inventive process:

The feed device comprises essentially a cylinder-piston unit 1, by means of which a pressure plate (not illustrated) is displaced and which presses on the end of an extrusion product which is to be sliced and pulsedly pushes it forward in the longitudinal direction by the thickness of one slice as soon as a cutting element passes through a rotating stage in which the cutting element is in its entirety outside the extrusion projection.

The cylinder-piston unit 1 is loaded with oil from a tank 4 by a pump 2 which is driven by a motor 3. For this purpose, the pump 2 is connected to the tank 4 via a vacuum pipe 5, and to the cylinder-piston unit 1 via a pressure pipe 6. The pipe 6 connects from pump 2 initially to a solenoid valve 7, from there to a volume control 8 and via a non-return valve 9 to a cylinder 10 of the unit 1, whereto is it connected in such a manner that the portion of the cylinder 10 located at the rear of the piston 11 is loaded.

The portion of cylinder 10 located at the front of the piston 11 is connected to the tank 4 via a compensating pipe 12 which is ducted via the solenoid valve 7, so that in any position of the piston 11 the cylinder 10 is fully loaded with oil which, on displacement of the piston 11, is forced back via the compensating pipe 12 into the tank 4, or again sucked out of the tank 4 respectively, at the same amount as oil is fed via the pressure pipe 6 into the cylinder 10, or is again ducted into the tank 4 during the return of piston 11 into its initial position. To return the piston into its initial position, the solenoid valve 7 is set so that the pressure pipe 6 and the compensating pipe 12

exchange the functions they perform during the pulsed thrust of the piston. Independently thereof, oil for a differential circuit can be returned via a bypass pipe 14 having a non-return valve 15 from the part of the cylinder 10 located at the rear of the piston 11 into the compensating pipe 12.

A safety valve 17, which will respond under extraordinary conditions, can be opened via a pipe 16 which is connected to the pipe 6 between the pump 2 and the solenoid valve 7, in order to permit bypass circulation of the oil which may still be pumped by pump 2, thereby preventing the system from being overloaded.

Furthermore, a branch pipe 18 connects from the volume control 8 via a filter 19 to the tank 4, thereby continuously cleansing a portion of the oil stream.

A hydraulic accumulator 20, which is connected to the pipe 6 between the non-return valve 9 and the cylinder 10, is an essential part of the system. The hydraulic accumulator 20 permits the conveying of a constant volume of oil independent of whether the piston 11 is in motion so as to produce a thrust cycle or stationary. If the piston 11 is also blocked due to an extrusion product being prevented from moving further by a cutting element, then the pressure in pipe 6 increases. However, this pressure increase is limited in that oil escapes into the hydraulic accumulator 20 which is then loaded.

At the beginning of the following feed cycle, the blockage of piston 11 is lifted by renewed displacability of the extrusion product to be sliced. Thereafter, the piston performs a required feed movement which corresponds with the slice thickness, in which respect the feed force is composed of the pressure of the volume flow which is continuously

conveyed via the pipe 6 and of the pressure of the volume flow which is added to the latter, which becomes effective by a discharge of the hydraulic accumulator due to a pressure drop.

Thus, the hydraulic accumulator 20 affects a limitation of a pressure drop as it does during a limitation of an increase in pressure. At the same time, the pump 2 delivers a substantially constant volume flow which can be maintained during the entire cutting process of an extrusion product.



Patent Claims

- 1: Process for cutting an extrusion product into slices, wherein the extrusion product is pulsed forward in the direction of its longitudinal extent, whilst a cutting element, which rotates around an axis in parallel with the longitudinal extent of the extrusion product, cuts a respective slice of an extrusion product between two forward pulses and, at least for the duration of the cutting process, substantially covers a then newly developing end surface of the extrusion product, characterised in that the extrusion product is continuously subjected to a feed pressure which is limited to an upper and a lower pressure value, both of which are adjustable in that, in the event that the adjustable upper pressure value is exceeded, an accumulator is charged so that a further pressure increase is prevented, and in the event of dropping below the adjustable lower pressure value, an accumulator is discharged so that a further pressure drop is prevented.
- 2: Hydraulic feed device, comprising a cylinder-piston unit which is charged by a pump via a pipe which is fitted with a non-return valve, for carrying out the process according to claim 1, characterised in that a hydraulic accumulator (20) is connected to the pipe (6) between the cylinder-piston unit (1) and the non-return valve (9).
- 3: Device according to claim 2, characterised in that the hydraulic accumulator (20) is divided by an elastically deformable separating wall into two



chambers, one of which is connected to the pipe (6) connecting to the cylinder-piston unit (1).

- 4: Device according to claim 3, characterised in that the separating wall in the hydraulic accumulator (20) is equipped with means for changing its return force.