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APPARATUS FOR KNEADING AND MIXING RUBBER
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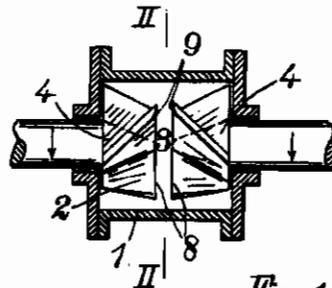


Fig. 1

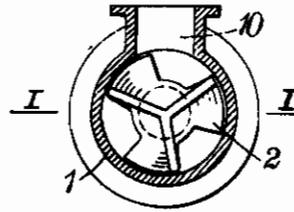


Fig. 2

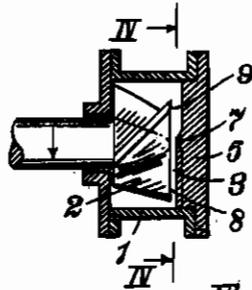


Fig. 3

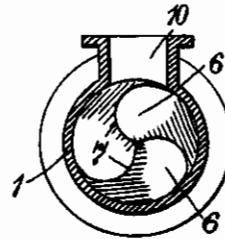


Fig. 4

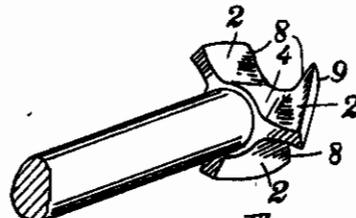


Fig. 5

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ALIEN PROPERTY CUSTODIAN

METHOD OF AND APPARATUS FOR KNEADING AND MIXING RUBBER

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This invention relates to a method of and apparatus for kneading and mixing rubber and other plastic materials of a like or similar nature.

Generally speaking, two different types of machines are known for this purpose, namely, mixing rolls on the one hand and kneading and mixing machines on the other hand, both types being available in single or double spindle design.

In the case of mixing rolls the actual mixing process is confined solely to that point at which the two rolls approach nearest to one another and impart to the rubber substance a characteristic pushing and masticating motion. The use of mixing rolls is a comparatively tedious and lengthy operation, for which reason in many instances kneading and mixing machines are found to be preferable.

The double-spindle kneading and mixing machines have two mixing rolls, which are mounted to be parallel to one another and are each rotatable in a depression of semi-cylindrical cross-section in the bottom of a trough. The mixing rolls themselves consist of rotatable cylindrical bosses extending through the trough longitudinally and having thereon one or more wings, ribs or blades of equal or unequal pitch. The mixing rolls are usually rotated in opposite directions. The actual mixing and kneading process carried out on the material situated in the space between the rolls, the blades and the side of the trough is always effected in such a way that the material is carried by the mixing rolls to a point above a so-called saddle and by the opposite rotation of the rolls is there kneaded together. This method of kneading and mixing requires a comparatively long time and necessitates extremely heavy and expensive machines.

As already stated, single-spindle machines for kneading and mixing rubber are also known. In these machines a longitudinally disposed shaft furnished with mixing blades and rotatable about its own axis operates in a hollow cylindrical container. The mixing blades are arranged diametrically opposite to one another on their common shaft, usually in helical disposal according to a certain pitch. Owing to the provision of the blades on a common shaft and the uniform speed and direction of rotation of the blades thus brought about there is always considerable danger of the rubber or like material being rolled or balled together. It is for this reason that machines of this character for the treatment of rubber or like substances have not acquired any significance in practice.

It is the object of the invention to devise a new

process for kneading and mixing rubber and like materials, and to provide a kneading and mixing machine which is particularly adapted for carrying out such process.

A further object of the invention is to eliminate the disadvantages attendant on the previously known methods of kneading and mixing rubber and like materials and on the machines employed for this purpose, and to provide a new method and apparatus by which the kneading and mixing operation can be carried out much more effectively, rapidly and cheaply than heretofore.

Whereas in the known machines the kneading and mixing operation has been carried out in practice in the space between two elements disposed parallel to one another, the kneading and mixing operation according to the invention takes place in a working space which is not parallel to the longitudinal axis or axis of rotation of the kneading and mixing elements, but is disposed transversely thereto.

According to the invention, the material to be kneaded and mixed is forced axially always in the one direction, i. e., towards the interior of the trough, in positive fashion into the transversely disposed working space, where it is subjected to a treading, squeezing and drawing action between the relatively rotating kneading and mixing elements, and thus to a very peculiar but nevertheless extremely rapid and efficient kneading and mixing process.

The invention is illustrated by way of example in the accompanying drawings, in which

Fig. 1 is a section through the improved machine according to the invention taken on the line I—I in Fig. 2.

Fig. 2 is a cross-section on the line II—II in Fig. 1.

Fig. 3 is a sectional view of an embodiment, in which one of the two mixing elements situated axially opposite to one another is arranged to be stationary.

Fig. 4 is a cross-section taken on the line IV—IV in Fig. 3, viewed in the direction of the arrows.

Fig. 5 is a perspective view of a preferred embodiment of kneading and mixing element.

With reference to the drawing, two kneading and mixing tools are arranged in a kneading and mixing trough *t*, which can be closed on all sides or may also be partially open, not as heretofore in parallel disposal side by side, but axially opposite to one another. In Fig. 1 both kneading and mixing elements are rotatable independently of one another. The design of the kneading and

mixing elements intended for a machine according to Figs. 1 and 2 is disclosed in a preferred embodiment in Fig. 5.

The kneading blades or wings 2 of these elements are each mounted on a boss 4, which is conveniently tapered in the direction towards the working space 3 and is preferably of conical form, the blades or wings having a certain angle of pitch with respect to the axis of rotation of the boss, so that the material being treated is always forced towards the interior of the trough into the working space 3 formed between the two elements transversely to their axis of rotation. The direction of rotation of the kneading and mixing elements may either be equal or opposite dependent on the disposal of their wings or blades. If their direction of rotation is the same, the speeds of rotation must be different. If they rotate in opposite directions, their speed of rotation can be selected as desired, and if necessary they can be allowed to rotate at equal speeds. It is also possible under the invention to arrange for one of the two mixing and kneading elements to be stationary, in which connection reference is made by way of example to the embodiment illustrated in Fig. 3.

In this case only the element shown on the left is arranged for rotation, whilst the co-operating element is mounted rigidly in the machine or its trough. In the embodiment according to Fig. 3 the stationary element is designated 5 and comprises in substance a disc, which on its end face directed towards the rotary element is furnished with recesses 6, so that between the latter ribs or projections 7 acting as blades are formed, which serve to guide the material under treatment towards the working space 3 in substantially the same fashion as the blades of a kneading and mixing element (which if desired may also be stationary) in the embodiment according to Fig. 1.

The blades, wings or ribs can be provided in any desired number and with any desired pitch. In the case of kneading and mixing elements having a plurality of wings all of the wings, blades or ribs may have the same pitch or may differ in pitch. Further, the wings in the case of kneading and mixing elements having a plurality of wings may have the same radial dimensions or different radial dimensions. Moreover, a relatively slowly rotating kneading and mixing element may have a larger number of wings, blades or ribs than a co-operating, rapidly rotating kneading and mixing element. Similarly, the pitch angles of the wings of a comparatively slowly rotating kneading and mixing element may be larger than those of a co-operating rapidly rotating element.

The size of the operating space 3 between the oppositely disposed kneading and mixing elements will depend substantially on the nature of the material being mixed and kneaded.

It is not essential that the working space between all end edges 8 of the wings or blades of both elements be of the same extent. The blades or wings may also be of different size longitudinally to the axis of rotation and may also have different forms. The arrangement may also be such that the width of gap between the end edges 6 or 7 of the wings or blades rotating one past the other varies regularly or irregularly. It

is advisable to round off the end edges of the blades—as clearly indicated at 9 in Fig. 5—so that they will at no time exercise a cutting or direct shearing action on the material in the operating space 3 but, on the contrary, assist in forcing the material to be kneaded into the working space and subjecting it to friction.

The trough and, if desired, also the kneading and mixing elements can be furnished with suitable cooling means. The provision of such cooling means is considered to be a practical measure not calling for particular illustration or description. The feeding and discharging of the machine can also be effected in any desired manner.

The operation of the machine is as follows: The material to be kneaded and mixed is introduced through an opening 10, which will usually be situated at the top of the trough, and is thus immediately subjected to the action of the kneading and mixing elements. The kneading and mixing elements either rotating in the same direction at different speeds or in different directions at the same or different speeds draw the material definitely into the trough by means of the oblique blades, ribs or wings and force it axially into the working space 3. In the working space 3 a rapid and highly effective kneading and mixing action takes place, the end edges 8 of the elements rotating past one another acting on the material with a frictional, squeezing, treading and pulling effect and also with a tendency to press the material together. The speed of rotation of the elements in relation to one another, the pitch of the blades or wings, the width of the working space, and the cohesive, adhesive and friction capacity of the material being kneaded are naturally factors which must also be taken into account in the specific design of the machine, but these do not alter the fundamental idea of the invention which, as it will be appreciated, resides in the kneading and mixing of the material in a working space situated transversely to the axis of rotation of the kneading and mixing elements.

The saddle effect on the material under treatment hitherto occurring in the machines having kneading and mixing elements disposed parallel to one another and taking place only once upon each revolution occurs in the machine according to the invention in a multiplied form dependent on the number of blades or wings provided.

The open character of the kneading and mixing elements in the direction towards the working space results in the interior of the trough, longitudinally thereof, in a multiplicity of hollow spaces in which the material can be taken up in comparatively large quantities, to be forced axially towards the centre, or in other words towards the transverse working space. As there are no shafts passing longitudinally through the trough as supports for the kneading wings or blades, the latter each being arranged independently on a boss, and these bosses being arranged axially opposite to one another to leave a certain intermediate space and preferably being of conical form, the new machine possesses a considerably greater capacity than the known kneading and mixing machines having a trough of the same size.

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