March 7, 1944. F. E. BROWN **2,343,529**

MACHINE FOR EXTRUDING RUBBER AND THE LIKE

Filed July 18, 1941 4 Sheets-Sheet 1

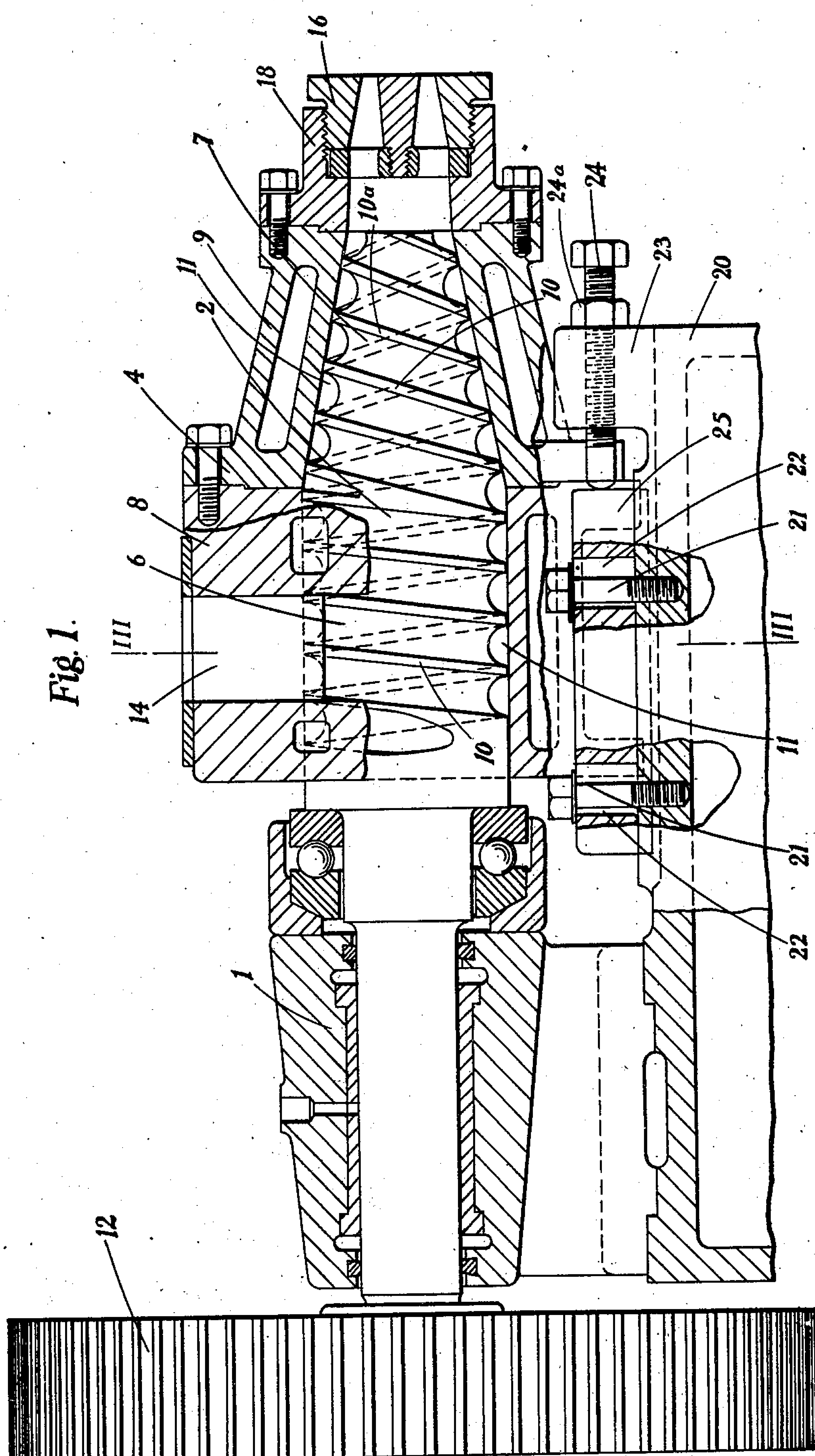

Fig. 1.

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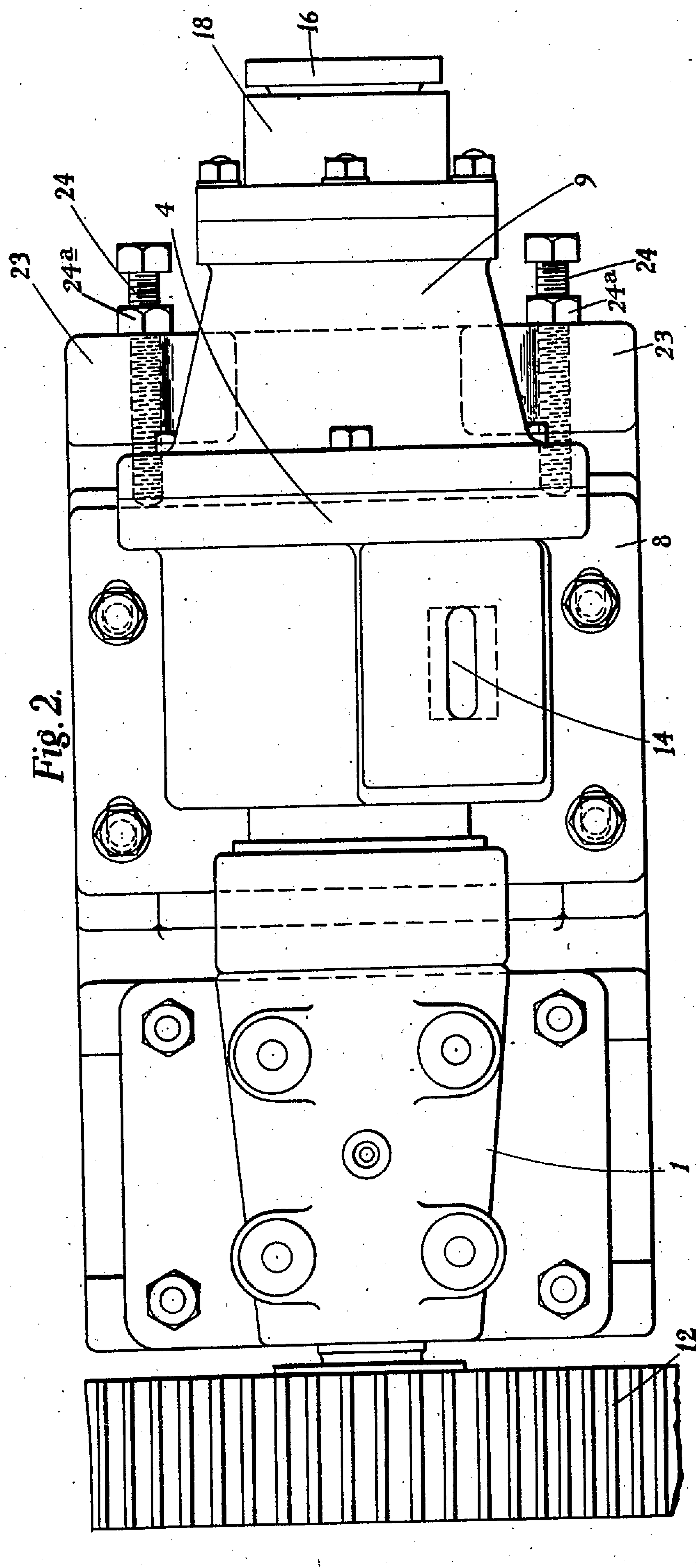

Fig. 2.

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Fig. 3.

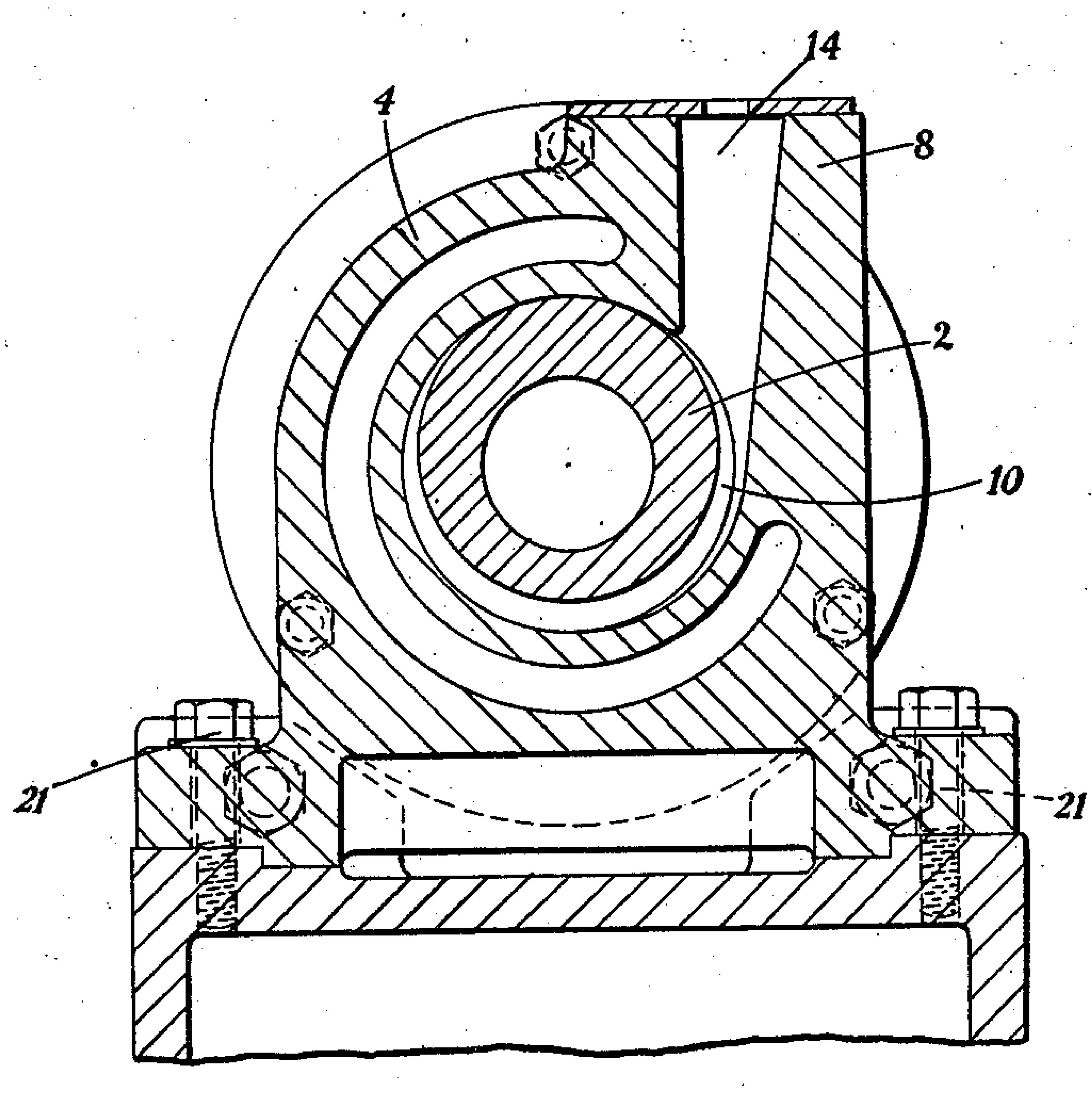

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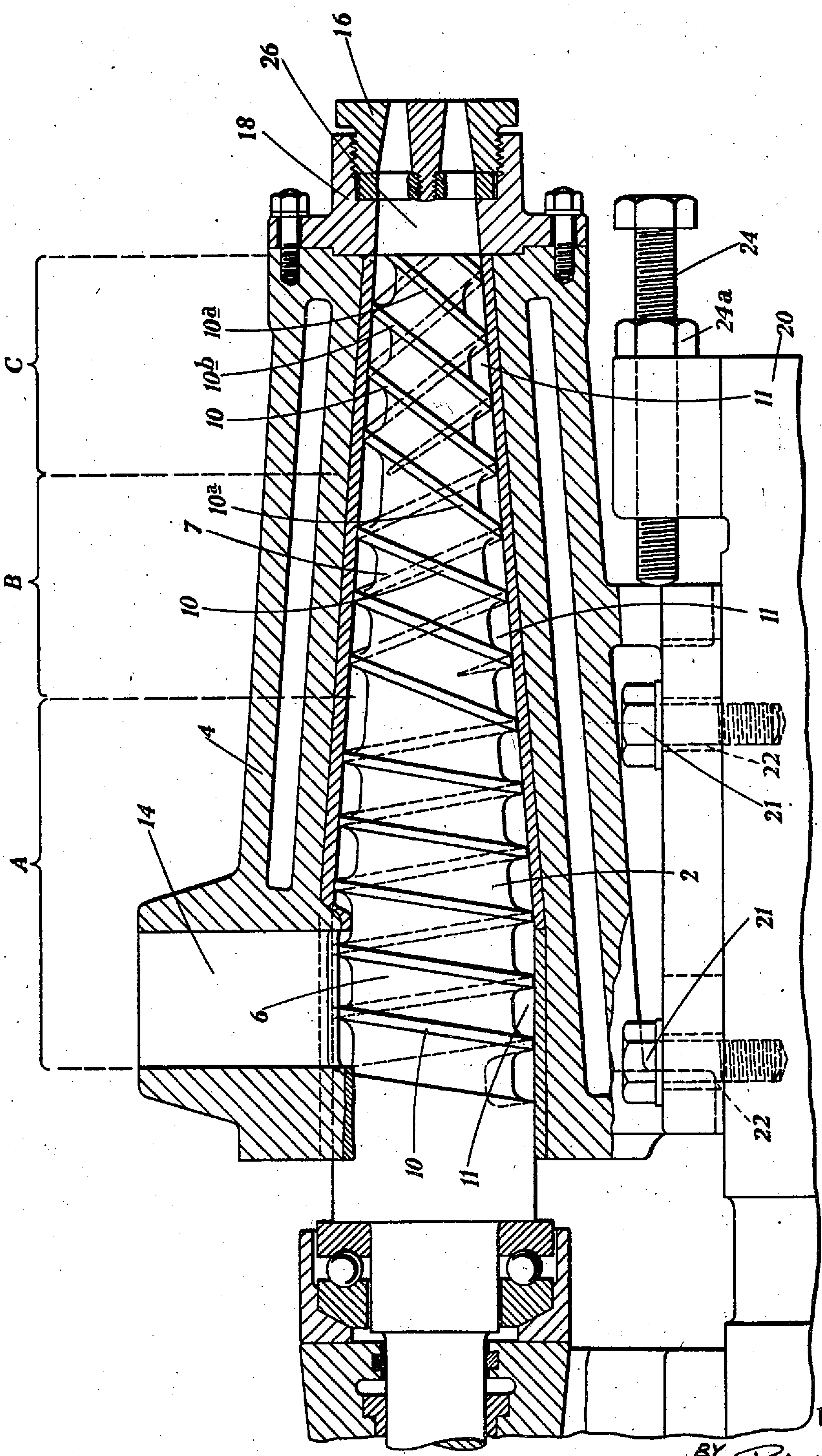
Fig 4.



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Patented Mar. 7, 1944 2,343,529

UNITED STATES PATENT OFFICE

2,343,529

MACHINE FOR EXTRUDING RUBBER AND THE LIKE

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Application July 18, 1941, Serial No. 403,041
In Great Britain November 9, 1939

8 Claims. (Cl. 18—12)

This invention relates to machines for extruding rubber and the like and to feed scrolls for use therein.

The machines which are most commonly used for this purpose today and which have been in use for many years have a feed scroll working in a fixed casing provided with a radial hole through which the rubber is taken in. The rubber is moved along the scroll as a consequence of the angularity of the groove of the scroll and the friction between the rubber and the fixed casing. The efficiency of such machines is low. This efficiency is measured as the ratio between the amount of material which is extruded per unit length of time and the volume swept out by one complete turn of the scroll in that time, and is generally of the order of 33% for rubber and 25% for "dead" material like ebonite. The provision of a feed roll which forces the material into the scroll at the feed end increases the efficiency to some extent and can, indeed, raise the efficiency when rubber is being extruded to as much as 40%. The provision of such a feed roller however is a complication which it is desirable to avoid because of the difficulty of providing adequate bearings in the very limited space which is available.

There is thus a good deal of room for improvement particularly when it is considered that the efficiency is constantly being decreased as wear of the scroll or of the casing which surrounds it, takes place. A test carried out on a machine of modern design still in use shows that the output capacity had been reduced by 25% as a result of wear of the scroll.

The applicant has now found that the efficiency of an extruding machine in which the material is fed to the die by means of the scroll can be quite substantially increased if the scroll has more threads at the delivery end than at the feed end, the volumetric capacity per unit length of the scroll being roughly constant over its whole length. Best results have been obtained when the scroll has been tapered towards the delivery end and the scroll has had a single thread at the feed end, two threads over its intermediate portion and three threads at the delivery end. With such a scroll, an efficiency of 45% without the use of a feed roller has been obtained when extruding rubber.

The tapering of the scroll has an important bearing on the efficiency of the machine and also provides a simple method of adjusting the parts of the machine so as to compensate for wear. Thus, if the casing which, of course, is internally tapered, is mounted for axial adjustment relatively to the scroll, wear can be taken up by the simple expedient of moving the casing into closer contact with the scroll. This is a feature of considerable importance.

The provision of a tapered scroll is also important from another aspect. In general, the die opening through which the material is extruded will be smaller than the end of the scroll. A sudden change in diameter at the delivery end will result in high pressure being exerted on the die gear without producing any correspondingly large increase of pressure on the material passing through the die opening. The reduction in diameter of the scroll at the delivery end allows the material to be fed more directly towards the die opening, and makes it feasible in most cases to taper the bore of the casing continuously from the end of the scroll to the die so that this part of the casing does not unduly oppose the forward movement of the material to the die.

In the ideal case, the volumetric capacity of the scroll would be the same at all points along it. With a continuously tapered scroll this would mean continuous alteration along the length of the scroll either of the pitch of the groove or grooves, or the width or the depth or of any combination of these three factors. There are, however, practical limits to the magnitude of the pitch, the width and the depth of the groove and in practice it is found that a sufficiently good approximation to the ideal can be obtained by dividing the scroll up into three lengths and keeping the pitch constant over each length and the cross-section of the groove constant throughout the length of the scroll.

Where, as is the case in the preferred form of the invention, the scroll is tapered and the cross-section of the groove is made constant throughout the length of the scroll, the diameter of the scroll at the feed end has to be made greater than is usual. This increased diameter is an advantage because it ensures a more positive feed intake of the material to be fed by the scroll.

In order that the invention may be properly understood and be more readily carried into effect, two examples of machines in accordance with the invention will now be described with reference to the accompanying drawings, in which—

Figure 1 is a longitudinal section through one form of extruding machine in accordance with the invention;

Figure 2 is a plan view of Figure 1;

Figure 3 is a cross-section taken on the line III—III in Figure 1; and

Figure 4 is a longitudinal section corresponding to that shown in Figure 1 through a machine having a different feed scroll.

The machine shown in Figures 1 to 3 has a base 20 on which is fixed a casing 4 which surrounds and fits a feed scroll 2. The scroll 2 is axially fixed and is mounted for rotation in a bearing 1 through gearing 12 driven by any suitable means not shown here. The rear or feed end 6 of the scroll is parallel and the front or feed end 7 is tapered. The two parts 8 and 9 of the casing 4 are correspondingly shaped.

Over the parallel portion 6, the scroll has a single thread 10 and over the tapered portion 7 it has a double thread 10, 10a. The groove 11 defined by the threads has the same depth and width throughout the length of the scroll.

The rear portion 8 of the fixed casing is provided with a feed hole or passage 14 which is tangential to the rear end of the scroll. The material to be extruded is fed through this feed hole and is moved towards the delivery end by the combined effect of the slope of the thread 10 and the friction between it and the casing.

At the end of the casing 4 beyond the delivery end of the scroll an internally screw-threaded ring 18 is provided which receives an appropriately screw-threaded extruding die 16. The material which is delivered from the end of the scroll is forced through this die and emerges as a continuous rod, strip or tube of a cross-section determined by the shape of the die.

It has been found that the volumetric efficiency of such a machine is quite substantially higher than that of the normal extruding machine which has a scroll which is parallel throughout its length and a groove of constant pitch. The full reasons for this important improvement are not fully understood but that the improvement exists is quite certain.

Constant use of the machine produces wear of the scroll and of the fixed casing which surrounds it. In the machine shown here provision is made for taking up this wear. It will be seen that the rear part of the casing is fixed to the bed plate 20 by means of screws 21 which pass through elongated holes 22. It will also be seen that the bed plate 20 has a pair of lugs 23 at the front through which pass adjusting screws 24. These screws abut against a part 25 of the casing. If then, as a result of wear, the clearance between the scroll and the tapered part 9 of the casing becomes unduly large, it is merely necessary to loosen the screws 21 and tighten the screws 24 so that the casing is moved backwards relatively to the scroll. The casing is then secured to the base 20 in its adjusted position by re-tightening the screws 21 and adjusting the lock-nuts 24a on the screws 24. This very simple provision is of the greatest importance as it allows the efficiency of the machine to be maintained over a long period.

The essential parts of the machine shown in Figure 4 correspond to those of the machine described above. The machine shown here has, however, a different form of scroll 2. The rear end 6 of the scroll is again parallel and the forward end 7 is continuously tapered to the delivery end. Over the parallel portion, the scroll, as before, has a single thread 10. This extends over the whole of the length A which includes a part of the tapered portion of the scroll. Over the intermediate length B the scroll has a double thread 10, 10a, and over the portion C at the delivery end it has three threads 10, 10a, 10b. The groove 11 is of the same cross-section everywhere except at the junction of the lengths A, B and B, C.

The casing 4 differs from that shown in Figure 1 in that it is made in one piece, but it is provided with the same kind of adjusting means as are shown in Figure 1.

The ring 18 which connects the die 16 to the casing has a tapered portion 26 forming a continuous extension of the bore of the casing. This is quite important because it ensures that there is no sudden diminution in diameter of the passage through which the material has to pass on the way to the die. There is then no undue opposition to the delivery of the material.

This form of scroll gives a somewhat better efficiency than that shown in Figure 1.

The multiple thread at the delivery end of the scroll causes the material to be delivered from the scroll to the die from a number of points round the scroll simultaneously. This has the important advantage of equalising pressure at all points within the die and of consequently leading to the production of an extruded article having no local blemishes or faults.

If desired, a feed roller can be provided to give a more positive feeding action at the feed end of the scroll but, in general, this is not necessary. The efficiency of the machine shown here in which no such feed rolls are provided is higher than that of the standard machine provided with a feed roll.

Neither of the two scrolls illustrated and described here is of strictly constant volumetric capacity at all points along its length. The volumetric capacity is, however, roughly constant so that there is no great tendency towards important variations in the volumetric rate of feed at different points along the scroll.

I claim:

1. An extruding machine for rubber and like material comprising a casing and a feed scroll within and coacting with said casing said feed scroll having at least one more thread along a part of its length adjacent its delivery end than along the remainder of its length, the volumetric capacity of the scroll being substantially the same at all points along its length, and said casing having an open end at the delivery end of the scroll said open end constituting the sole outlet for extruded material.

2. An extruding machine for rubber and like material comprising a casing and a feed scroll within and coacting with said casing said feed scroll having at least one more thread along a part of its length adjacent its delivery end than along the remainder of its length and said threads defining grooves of substantially the same cross-section throughout the length of the scroll.

3. An extruding machine for rubber and like material comprising a casing and a feed scroll within and coacting with said casing said feed scroll having at least one more thread along a part of its length adjacent its delivery end than along the remainder of its length and said casing having an open end at the delivery end of the scrool said open end constituting the sole outlet for extruded material, the scroll having a parallel portion adjacent the feed end and a tapered portion adjacent the delivery end and at least one more thread on its tapered portion than on its parallel portion, the said threads defining grooves of substantially the same cross section throughout the length of the scroll.

4. An extruding machine for rubber and like

material comprising a casing and a feed scroll within and coacting with said casing said feed scroll having at least one more thread along a part of its length adjacent its delivery end than along the remainder of its length and said casing having an open end at the delivery end of the scroll said open end constituting the sole outlet for extruded material, said feed scroll tapering towards the delivery end over the greater part of its length and having at least one more thread on a portion thereof adjacent its delivery end than on the remainder thereof, the said threads defining grooves of substantially the same cross section throughout the length of the scroll.

5. An extruding machine for rubber and like material comprising a casing and a feed scroll within and coacting with said casing said feed scrool having at least one more thread along a part of its length adjacent its delivery end than along the remainder of its length and said casing having an open end at the delivery end of the scroll said open end constituting the sole outlet for extruded material, the scroll having a parallel portion adjacent the feed end and having a single thread and a tapered portion adjacent the delivery end having two threads, the said threads defining grooves of substantially the same cross-section throughout the length of the scroll.

6. An extruding machine as set forth in claim 2 in which the scroll has a parallel portion adjacent the feed end and a tapered portion adjacent the delivery end and has at least one more thread on its tapered portion than on its parallel portion, the said threads defining grooves of substantially the same cross-section throughout the length of the scroll.

7. An extruding machine as set forth in claim 2 in which said feed scroll tapers towards the delivery end over the greater part of its length and has at least one more thread on a portion thereof adjacent its delivery end than on the remainder thereof, the said threads defining grooves of substantially the same cross-section throughout the length of the scroll.

8. An extruding machine as set forth in claim 2 in which the scroll has a parallel portion adjacent the feed end having a single thread and a tapered portion adjacent the delivery end having two threads, the said threads defining grooves of substantially the same cross-section throughout the length of the scroll.

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