July 23, 1946. F. T. GRIFFITHS 2,404,630

EXTRUSION MACHINE

Filed Sept. 16, 1943 4 Sheets-Sheet 1

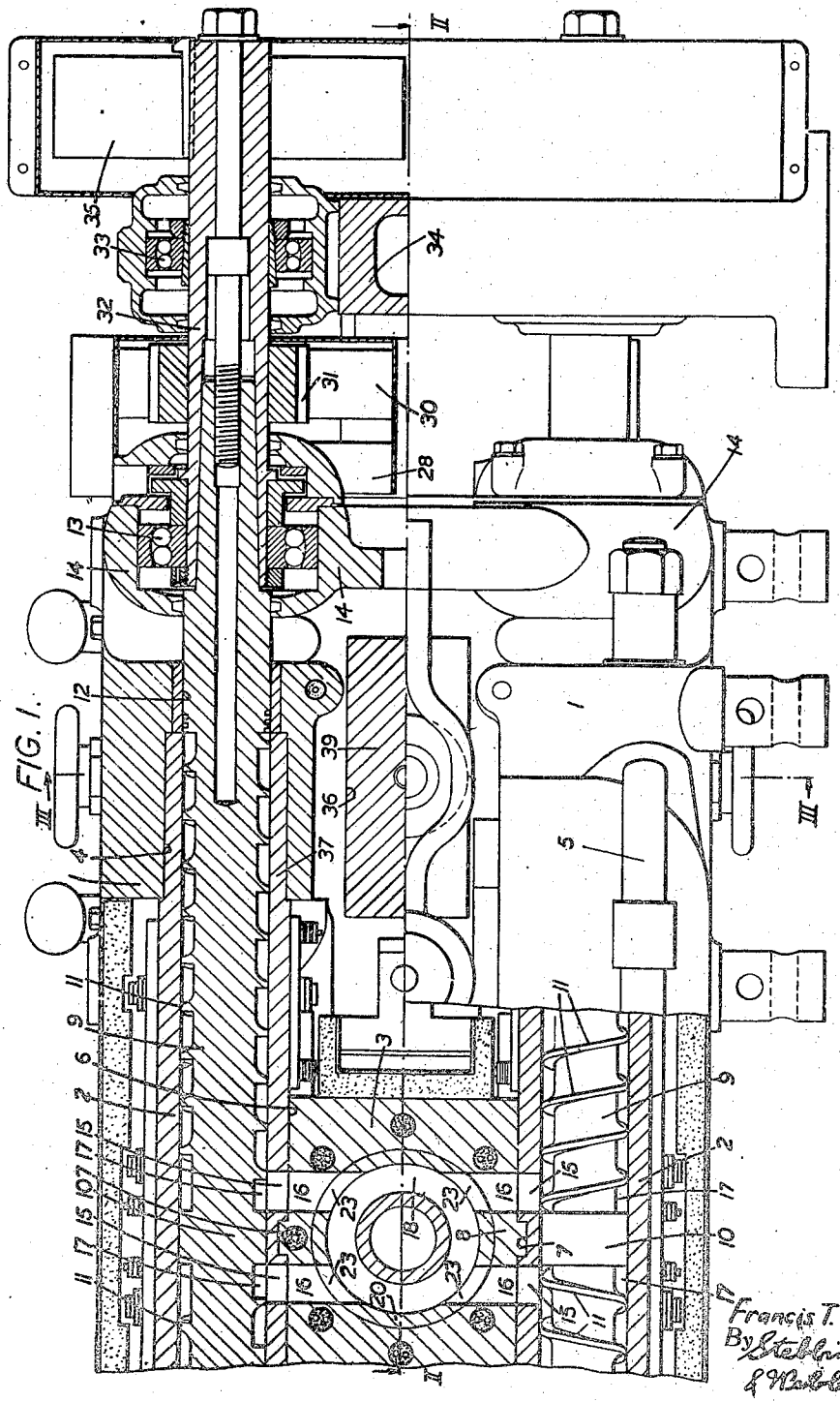


FIG. 1.

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EXTRUSION MACHINE

Filed Sept. 16, 1943 4 Sheets-Sheet 2

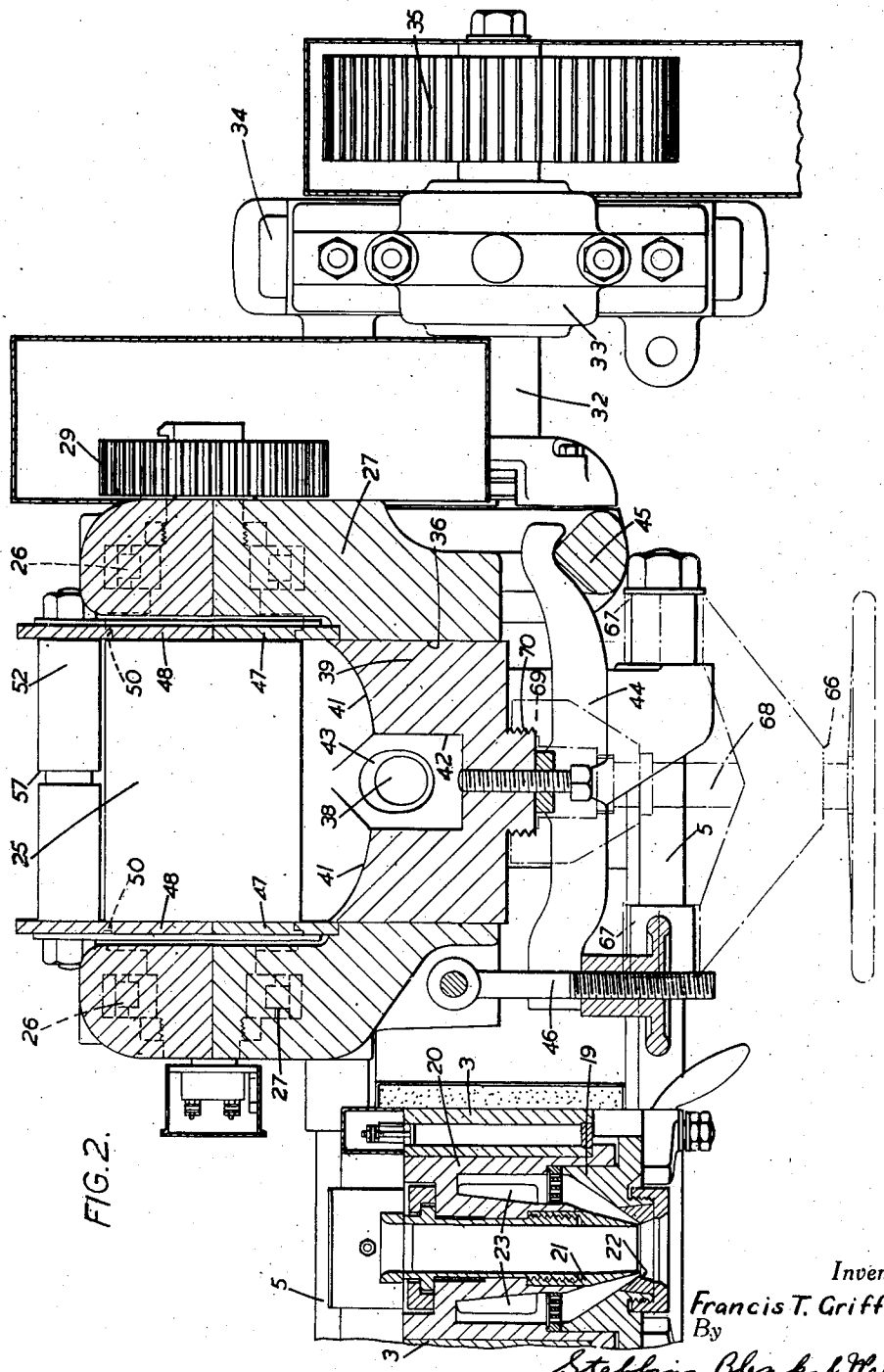


FIG. 2.

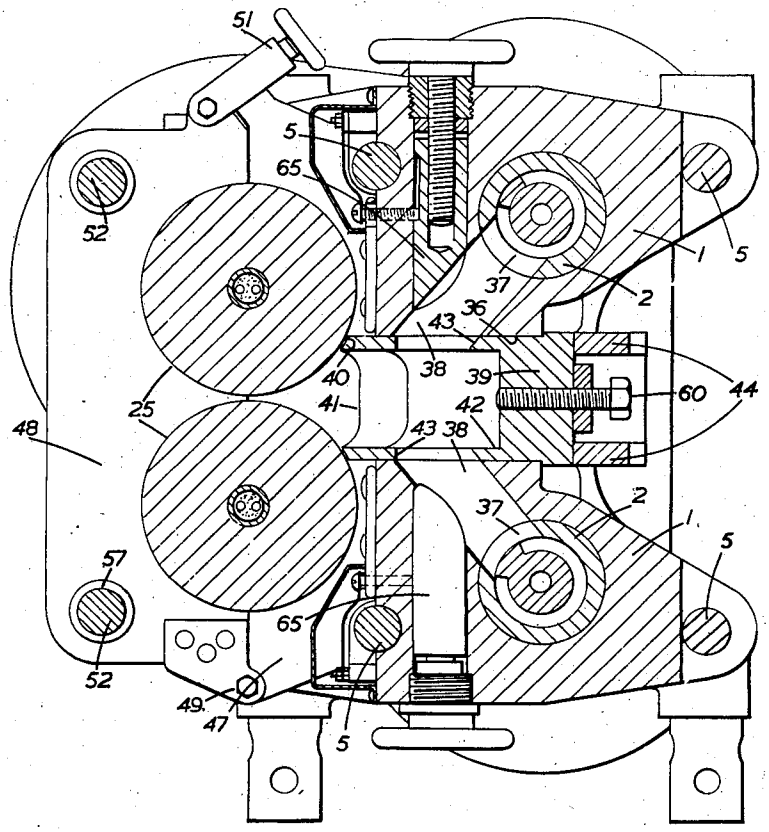
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EXTRUSION MACHINE

Filed Sept. 16, 1943 4 Sheets-Sheet 3

FIG. 3.



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EXTRUSION MACHINE

Filed Sept. 16, 1943 4 Sheets-Sheet 4

FIG.4.

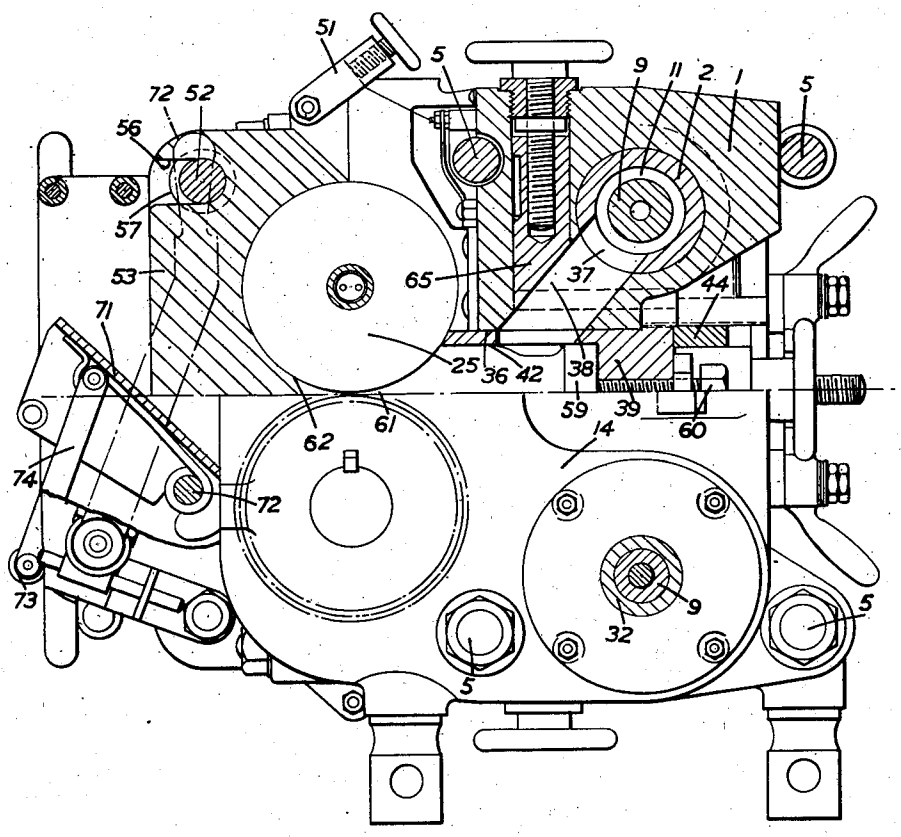
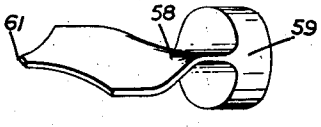


FIG.5.



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UNITED STATES PATENT OFFICE

2,404,630

EXTRUSION MACHINE

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Application September 16, 1943, Serial No. 502,603
In Great Britain October 9, 1942

8 Claims. (Cl. 18—12)

1

This invention relates to machines for extruding plastic material, for instance, rubber mixes or synthetic plastic compositions such as polyvinyl chloride compositions and compositions consisting principally of solid polymers of ethylene. In machines of the kind with which the invention is concerned the plastic material is delivered to the feed end of a screw thread impelling device by means of a pair of power driven feed rolls. The material passes through the nip in the rolls into a feed chamber with an outlet which leads to a feed opening at the rear end of the impelling device. A forced feed arrangement of this kind has many advantages and with certain materials—notably some synthetic plastics—is a practical necessity. However, periodically it is necessary to clean these feed rolls and the feed chamber, for instance, when it is desired, to extrude a mix of a different composition or colour. In many machines it is impracticable to do this without dismantling the feed device, in others the operation of cleaning is facilitated to some extent by providing a removable door in the feed chamber wall. By the present invention we provide an improved form of construction of extrusion machine which permits of the feed device being more easily and thoroughly cleaned than has hitherto been possible without dismantling a large portion of the machine. In our improved form of construction the plastic material is delivered into a feed chamber which is readily removable to expose the feed rolls and render them accessible on the delivery side without dismantling them and to give access to the interior of the feed chamber.

Preferably the feed chamber is arranged to slide in a direction perpendicular, or substantially perpendicular, to a plane containing the axes of the feed rolls into or out of an operative position in which its outlet registers with the feed opening of the impelling device, the wall of the chamber in which the outlet is located making a sliding joint with a face around the feed opening. Preferably also the open front end of the chamber, that is the end adjacent the rolls, has edges which fit the rolls and serve as scrapers, provision being made for limited adjustment of the operative position of the chamber to provide for clean scraping of the rolls or for leaving a film of plastic material thereon, whichever is more suited to the working conditions. The feed chamber will generally extend the full effective width of the rolls, so that when it is withdrawn and removed, the rolls are exposed over their effective

2

widths and the interior of the feed chamber is completely accessible.

The removable feed chamber is particularly advantageous when employed with machines comprising two impelling devices fed by a single pair of driven feed rolls. In this case the feed chamber is located between the two impelling devices and furnished with an opening in each of two opposite walls which registers with the feed entrance of the adjacent impelling device. In such cases it is preferred to make provision for the insertion of a removable division plate in the chamber and for the insertion of a co-operating, correspondingly located division plate on the approach side of the rolls, to allow the delivery of separate mixes to the two impelling devices fed from the same removable chamber.

To enable the invention to be more fully understood an example of a multiple screw extrusion machine embodying the invention will now be described with the aid of the accompanying drawings wherein—

Fig. 1 is a view, partly in elevation and partly in section in a plane containing the axes of the impelling devices, of a part of the extrusion machine.

Fig. 2 is a sectional plan on the line II—II of Figure 1,

Fig. 3 is a cross-section on the line III—III of Figure 1,

Fig. 4 is a view corresponding to Fig. 3 showing the machine fitted with division plates and spring-pressed hopper plates, and

Fig. 5 is a perspective view of the inner division plate.

The machine shown in the drawings is of the kind described in my co-pending Patent 2,367,394 and comprises two pairs of screw thread impelling devices, each of a type in which the inner of two longitudinally extending concentric members constituting the impelling device is rotatably driven, the two devices of each pair being in axial alignment and having their respective rotating parts integral with one another at the delivery ends, the two pairs being disposed at diametrically opposite sides of the extrusion chamber with their axes parallel with one another and at right angles with that of the extrusion chamber. Except for its drive, the machine is symmetrical about a vertical plane containing the axis of the extrusion chamber and consequently it is unnecessary to show or describe the complete machine.

The machine, of which rather more than one half is shown in Figures 1 and 2, is built up of a pair of end blocks 1, a pair of cylinders 2 and a

central block 3. The ends of the cylinders enter recesses 4 in the end blocks and are held therein by four tie bolts 5, which draw the cylinders and two end blocks together. The central block 3 is of general rectangular form and is located between parallel surfaces 6 on the central portions of the cylinders 2. These surfaces are flat except for recesses 7 which receive correspondingly shaped projections 8 on the co-operating surfaces of the block and serve positively to restrain the central block from moving relatively to the cylinders. The latter have a smooth bore and form the outer concentric members of the impelling devices. The inner concentric member of each pair of axially aligned impelling devices is constituted by a shaft 9, of which the portions lying within the cylinder and to each side of a central portion 10 serving as a central bearing, each carry a screw thread 11, the thread on one portion being of opposite hand to that on the other. The angle of the thread is advantageously about 75–80°. At each end, the shaft 9 projects through a bushed opening 12 in the bottom wall of the recess 4 receiving the spigot end of its cylinder 2, and is rotatably supported by a ball bearing 13 housed in a bracket 14 extending from the end block 1. Delivery openings 15 are provided in the walls of the cylinders 2. These are located one on each side of the bearing portion 10 of the shaft and register with delivery ports 16 in the wall of the central block 3 and serve to place the four annular delivery chambers 17 in communication with a removable extrusion chamber 18 housed in the central block. This extrusion chamber is built up of a pair of telescoped sleeves 19 and 20, one of which carries an inner die or point 21, and the other an outer die or matrix 22. Four openings 23, are provided in the wall of the outer sleeve 20 which register with the ports 16 in the walls of the block 3 when the chamber is correctly positioned in the bore of the block.

To one side of each end block are a pair of feed rolls 25 mounted with their axes, one vertically above the other, parallel to those of the impelling devices and equidistant from a horizontal plane lying midway between the upper and lower pairs of impelling devices. The rolls are supported at both ends by roll shafts turning in roller bearings 26 housed in brackets 27 on the end blocks 1, as will be seen from Figure 2. The roll shaft of the upper roll carries a gear wheel 28 (Figure 1), which meshes with a corresponding wheel 29 (Figure 2) on the projecting end of the lower shaft. Both rolls are driven by applying a drive from the part 32 of the upper impeller shaft to the upper roll by means of a second gear wheel 30 on the upper roll shaft which meshes with a gear wheel 31 on the part 32. This part 32 is supported by the bearing 13 and by a second bearing 33 mounted on a pedestal 34 and is driven by means of a wheel 35 on the end thereof which overhangs the bearing 33.

In the block 1 is a passage 36, which extends from side to side of the block. As will be seen from the drawings this passage lies midway between the upper and lower impelling devices and respectively below and above the feed openings thereof and is of rectangular cross-section. In some cases, however, it may be an advantage to make it of circular cross-section to facilitate machining operations and to give greater access to the feed openings. The feed opening of the upper impelling device comprises an aperture 37 in the cylinder 2 and an inclined port 38 in the end block 1, which registers with the aperture 37 and

opens into the upper wall of the passage 36; the feed opening of the lower device comprises a similar aperture 37 in the cylinder and a correspondingly inclined port 38 opening into the lower wall of the passage. Slidably positioned in the passage 36 is a block 39 of cross-sectional shape corresponding to that of the passage. The horizontal edges of this block that lie at the front end thereof, by which is meant the end adjacent the feed rolls, are chamfered as shown at 40 to fit the upper and lower roll surfaces. Between these chamfered edges 40 the front face of the block is in the form of a rounded channel 41, of which the depth increases from a minimum at each end to a maximum in the central part, as shown in Figures 2 and 3 of the drawings. In the central part of the wall of this channel 41, is a recess 42 of cylindrical form which extends horizontally towards the rear end of the block 39. Openings 43 are provided in the upper and lower walls of the recess 42, which respectively register with the upper and lower feed openings when the sliding block 39 is in its operative position with its chamfered front edges 40 in, or almost in, engagement with the feed rolls 25. The channel 41 and recess 42 in the sliding block 39 form the interior of a removable feed chamber. This chamber is held in position in the end block 1 by a lever action bridge piece 44 which engages the rear end face of the block 39. One end of the lever 44 is of hook form and engages a fulcrum 45 carried by the end block 1 and the other end of the lever is engaged by a swing bolt 46 by means of which, the position of the block 39 in the passage 36 can be adjusted, within limits, as required.

The rolls 25 are fitted with side plates, each of which is common to both rolls and is split in a vertical plane containing the axes of the rolls. The two parts 47 and 48 are coupled together by a hinge 49 at their lower ends and are held together and in engagement with grooves 50 in the rolls by a swing bolt 51 carried at the top of one part and engaging a lug at the top of the other. The part 47 of each side plate lying on the delivery side of the rolls 25 fits against the neighbouring wall of the end block 1 and forms a smooth continuation of the adjacent side wall of the recess 36, which thus extends over the whole effective width of the rolls, as will be most clearly seen in Figure 2. The outer parts 48 of the side plates, that is the parts that lie on the approach side of the rolls 25, are held together by two tie bars 52 and form the side walls of a feed hopper, which may for cleaning purposes be swung down to give access to the rolls.

To render the machine capable of producing parti-coloured products by feeding different coloured stocks to the upper and lower impelling devices, the rolls may be provided with removable central division plates on their intake and delivery sides. As will be seen from Figure 4, the outer division plate 53 is shaped to fit against the outside halves of the circumferential surfaces of the two rolls 25 and is held in position by means of the two tie bars 52. These have circumferential grooves 57 to provide parts of reduced diameter which enter one in each of two slots 56 in the outer edge of the plate, the sides of the groove forming shoulders which engage the sides of the plate. To insert this outer division plate, the two swing bolts 51 are released, the two outer parts 48 of the side plates lowered, the centre plate 53 dropped into position on the grooved tie bars 52 and the assembly of three plates swung into the operative position and clamped there by

the swing bolts. The inner division plate **58** is of twisted form with end portions lying at an angle of 45° or more to one another. The width of the plate is equal to the diameter of the cylindrical recess **42** in the feed chamber block **39**. At its front end, the plate **58** lies vertically, its front edge being shaped, as shown in Figures 4 and 5, to fit against the parts of the roll surfaces lying between the chamfered edges **40** of the feed chamber block **39**. Within the part of the cylindrical recess **42** having the openings **43**, the plate lies at an angle of 45° to the vertical (or more, if the length of the recess permits) so that it divides this part of the recess into upper and lower parts, one of which is in communication with the bite of the rolls lying to one side of the central division plates and the other with the bite lying to the other side of that plate. This twisted form of division plate is preferably supported at its rear end by a plunger **59** which is a working fit in the cylindrical recess **42**. This permits of the endwise adjustment of the plate without rendering it ineffective as a separator. Adjustment is effected by means of a screw **60** working in the rear end wall of the feed chamber block **39**, access to the head of which is obtained through an opening in the bridge piece **44** holding the block in place. Preferably, the two division plates **53** and **58** make a V-joint wth one another in the nip of the rolls, the tip of the division plate **58** forming a tongue **61**, which enters a groove of corresponding form in the tip **62** of the plate **53**. The joint surfaces then extend inwardly from their outer edges in a direction counter to the direction of flow of stock past the entrances to the joint.

As the flow paths to the two impelling devices are similar, whether the central division plates are in position or not, the amount of stock fed to each device should normally be the same. Provision may, however, be made to regulate the flow by varying the cross-sectional area of the inclined ports **38** leading from the feed chamber by means of adjustable plugs **65** which enter the ports laterally.

Withdrawal of the feed chamber for cleaning purposes is conveniently effected by means of an extractor comprising a four-legged table **66** with feet **67**, which hook over the two tie bolts **5** on the opposite side of the machine to that on which the feed rolls are disposed. In the table is a screw-threaded aperture in which works a screw **68** carrying a rotatable cup **69** which screws on an externally screw-threaded boss **70** on the rear face of the block, as shown in broken lines in Figure 2 of the drawings. It will be apparent from this figure that by withdrawing the feed chamber block **39**, unobstructed access is obtained to the delivery side of the rolls over their entire effective width. When withdrawn from its housing in the end block, the feed chamber is very accessible and can be cleaned much more readily than can feed chambers of existing forms of construction.

In some cases it is advisable forcibly to feed the plastic stock to the driven feed rolls. An arrangement for doing this is shown in Figure 4. It comprises a pair of pressure plates **71**, one on each side of the division plate **53** and constituting the front walls of two feed hoppers of which the side walls are constituted by the plates **48** and **53**. The plates **71** are pivotally supported near their lower ends, each on a spindle **72** and pressed inwardly towards the rolls **25** by means of spring actuated cranks **73** connected to the upper part of the plate by links **74**. Each pressure plate may be held open to admit stock to the hopper by means of a handle **75** acting on the crank shaft, preferably spring coupled to the crank shafts. Naturally the invention is in no way limited to this particular form of pressure device. Any other suitable device may be used or, as indicated above, in many cases the machine may be used without such a device.

What I claim as my invention is:

1. A machine for the extrusion of plastic material, comprising at least one pair of screw-thread impelling devices each having its own feed opening, a readily removable feed chamber located between the two impelling devices and having a pair of outlets each registering with the feed opening of the adjacent impelling device, a pair of driven feed rolls for feeding plastic material into one end of said feed chamber, a removable division plate in said feed chamber dividing said feed chamber into two parts each containing one of said outlets, and a correspondingly located removable division plate on the approach side of said feed rolls cooperating with the first said division plate whereby to allow of the delivery by said rolls of different kinds of plastic material to the two impelling devices.

2. A machine for the extrusion of plastic material, comprising at least one pair of screw-thread impelling devices each having its own feed opening, a readily removable feed chamber located between the two impelling devices and having a pair of outlets each registering with the feed opening of the adjacent impelling device, a pair of driven feed rolls for feeding plastic material into one end of said feed chamber, a pair of side plates for the feed rolls, each plate being received in circumferential grooves at the ends of said rolls and divided in a plane containing the axes of the rolls into inner and outer parts hinged together at their lower ends, means for detachably securing the inner and outer parts of each side plate together at their upper ends, means for tying together the outer parts of the two side plates, a removable division plate in said feed chamber dividing said feed chamber into two parts each containing one of said outlets, and an outer division plate on the approach side of said rolls correspondingly located by said tying means and shaped to fit the rolls and make joint in the nip thereof with said division plate in said feed chamber, whereby to confine the delivery of plastic material fed to the part of said feed rolls lying to one side of said outer division plate to one of said impelling devices and delivery of that fed to the part of said feed rolls lying to the other side of said outer division plate to the other of said impelling devices.

3. A machine for the extrusion of plastic material comprising a screw-thread impelling device having a feed opening for the introduction of the material, a readily removable feed chamber open at one end and closed at the other and having a lateral outlet and slidable across the face of said feed opening into and out of an operative position in which said lateral outlet in the said chamber registers with the feed opening, and a pair of driven rolls for forcing material into the open end of said slidable feed chamber when in its operative position, and releasable means for holding the said slidable feed chamber in its operative position.

4. A machine for the extrusion of plastic material, comprising a screw-thread impelling device having a feed opening for the introduction

of the material, a removable feed chamber closed at one end and open at the other end and having a lateral wall with an outlet therein, and a pair of driven rolls for feeding material into the chamber through the open end thereof, said feed chamber being slidable across the face of said feed opening in a direction substantially perpendicular to a plane containing the axes of said feed rolls into and out of an operative position in which the lateral outlet registers with the said feed opening and the lateral wall of the chamber in which the outlet is located makes a sliding joint with a face around the feed opening, and releasable means for holding said removable feed chamber in said operative position.

5. A machine for the extrusion of plastic material, comprising a screw-thread impelling device having a feed opening for the introduction of the material, a removable feed chamber open at one end and closed at the other and having a lateral wall with an outlet therein, a pair of rolls for feeding the material into the open end of said feed chamber, said feed chamber being slidable across the face of said feed opening in a direction substantially perpendicular to a plane containing the axes of the feed rolls into and out of an operative position in which the lateral outlet registers with the feed opening and having at its open end edges shaped to fit the feed rolls and serve as scrapers therefor, and a releasable abutment for the closed end of said removable feed chamber and manually operable means for effecting a limited adjustment of said abutment whereby to adjust the operative position of said feed chamber to provide for clean scraping of the rolls or for leaving thereon a film of plastic material of appropriate thickness.

6. A machine for the extrusion of plastic material, comprising a pair of laterally spaced screw-thread impelling devices, a housing for the feed eends of both said devices having a through passage between, and extending transversely of, said devices and having ports in the wall of said passage each leading to the interior of one of said impelling devices, a pair of driven feed rolls at one end of said through passage, and a feed chamber comprising a block removably positioned in said passage, said block being a sliding fit in

said through passage and having at one end a pair of edges chamfered to fit the roll surfaces, a channel between said edges of which the depth increases from a minimum at each end to a maximum in the central part, and a recess of cylindrical form opening into the central part of the channel and extending towards the end of the block remote from the rolls and having in its circumferential wall and on opposite sides of said recess, a pair of openings one of which registers with one of said ports and the other of which registers with the other of said ports, when the block is in an operative position and releasable means engaging the end of said block remote from said rolls, for holding said block in said operative position.

7. A machine for the extrusion of plastic material, comprising a pair of laterally spaced screw-thread impelling devices, a housing for the feed ends of said both devices having a through passage between, and extending transversely of said devices and having ports in the wall of said passage each leading to the interior of one of said impelling devices, a pair of driven feed rolls at one end of said passage, and a feed chamber removably positioned in said passage, said feed chamber being a sliding fit in said passage and having an inlet end shaped to fit the delivery side of said feed rolls and lateral outlets which register with the ports in the wall of the passage, whereby said feed chamber can be withdrawn from said passage to expose the delivery side of said rolls.

8. An extrusion machine as specified in claim 6, wherein the feed chamber is fitted with a division plate comprising a front portion, which fits against the portions of the rolls between the chamfered edges of the feed chamber and lies in a plane substantially radial to the axes of the rolls, a rear portion twisted at an angle to the front portion, and edges fitting the walls of the cylindrical recess, whereby to confine the flow of plastic material from one side of the said division plate to one of the impelling devices, and that from the other side to the other of the impelling devices.

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