For convenience, the invention has been described and illustrated with reference to the dry spinning of cellulose triacetate, but it should be understood that both the process and apparatus are applicable to the spinning of other fiber-forming materials by wet, dry or melt spinning such as polyamides, polyesters, acrylics, vinyl chloride and vinylidene cyanide polymers and the like. Since the essential operative principle stems from rheological rather than chemical or mechanical characteristics, and suitable dimensional adaptations may easily be achieved within the context of such systems.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be further illustrated with reference to the accompanying drawing wherein:

FIG. 1 is a plane view of a section of a spinneret used in accordance with this invention with the orifices arranged in a circle around the periphery of the spinneret plate and their size exaggerated to indicate their appearance;

FIG. 2 is a sectional view showing the profile of the contemplated orifices; and

FIG. 3 is a schematic illustration of a dry spinning operation.

Referring now more particularly to the drawing, FIG. 1 shows a spinneret or jet plate **10** as viewed from the inlet side with orifices **11** each of which has the appearance of four concentric circles corresponding to the largest diameter of the orifice at the inlet face of the plate and the circles of intersection of the various frusto-conical portions and the cylindrical portion, at the outlet side of the spinneret plate.

As shown in FIG. 2 illustrating the profile of the contemplated orifice of spinneret **10**, the wall of the cylindrical portion is indicated at **13** with numerals **14, 15** and **16** identifying the walls of the first, second, and third frusto-conical portions of the orifices respectively.

In FIG. 3 there is shown a dry spinning cabinet **17** to which dope is supplied through a pipe **18**, being extruded through the spinneret **10** of FIGS. 1 and 2. Hot air is admitted to the cabinet **17** at **19** and is exhausted at **20** along with vapors of the dope solvent. The filaments **21** leaving spinneret **10** pass about a guide **22** and leave the cabinet at **23** being pulled as a yarn **24** by draw rolls **25**. The yarn **24** passes through a guide **26** and is twisted and taken up on a bobbin **27** by a conventional collector such as ring spinner **28**.

In addition to the fact that smaller orifices may be used in carrying out the process with the advantages described above, the process of this invention results in the formation of substantially less jet deposits than when various other orifice shapes are used, particularly in the case of the dry spinning of cellulose triacetate from solution in a solvent comprising a major proportion of a halogenated hydrocarbon. Moreover, the employment of the orifice profile of this invention results in considerably longer jet life, a more uniform filamentary product (e.g., in terms of cross-section) with better properties, e.g., of tenacity and elongation that is the case when spinnerets are employed with more conventional orifice designs. Improved dyeing properties may also be obtained.

Finally, the process of the invention using the distinct orifice shape as described above may be started up much more easily than other spinning processes, and makes possible the employment of higher spinning speeds without deterioration of filament properties.

The following example further illustrates the invention:

Example I

A 22 weight percent solution of fiber-forming cellulose triacetate having an acetyl value of 61.5 percent by weight calculated as combined acetic acid in a solvent mixture consisting of 91 percent of methylene chloride and 9 percent of methanol was extruded through a chromium plated stainless steel spinneret with a plate having a thickness of 1.016 mm. and with 5 orifices arranged in a circle each with a profile as indicated in FIG. 2. Cylindrical portion **13** of each orifice had a circular cross-section with a diameter of 0.034 mm. and a length of 0.018 mm. First frusto-conical portion **15** had an apex angle 17 degrees and a length of 0.035 mm.; second frusto-conical portion **16** had an apex angle of 30 degrees and a length of 0.20 mm.; and third frusto-conical portion **17** had an apex angle of 60 degrees and a length of 0.762 mm., each of the lengths being measured along the axis of the orifice. The resulting filaments passed through air in a spinning cabinet at 35 degrees centigrade and were taken up on a bobbin at a linear speed of 500 meters per minute after being withdrawn from the spinning cabinet. The yarn had a denier of 3.75 d.p.f., a tenacity of 1.35 grams per denier and an elongation of 35 percent.

After 24 hours of continuous operation from the time that the spinneret was installed, the jet deposits resulted in a reduction in orifice area equal to only 1.7 percent of the total due to deposited material when observed at 400 magnification. This represents a substantially smaller formation of jet deposits than is obtained when orifices of more conventional profile are used.

Example II

A 22 weight percent solution of fiber-forming cellulose triacetate having an acetyl value of 61.5 weight percent was extruded through the chromium plated stainless steel spinneret of Example I utilizing the procedure of Example I. The resulting filaments pass through air in a spinning cabinet at 40 degrees centigrade and were taken up on a bobbin at a linear speed of 350 meters per minute after being withdrawn from the spinning cabinet.

A 22 weight percent solution of fiber-forming cellulose triacetate having an acetyl value of 61.5 percent was extruded according to the procedure of the example of U.S. Pat. 3,210,451, Manning, utilizing the spinneret disclosed therein. The resulting filaments were passed through air in a spinning cabinet at 40 degrees centigrade and were taken up on a bobbin at a linear speed of 350 meters per minute after being withdrawn from the spinning cabinet.

Table I below shows the comparative jet deposit ratings of spinnerets utilized for long periods of time in the process of this invention and the prior art process and jet of U.S. Pat. 3,210,451:

TABLE I

Prior art jet—plated			Jet of this invention—plated		
Jet No.	Spinning time hrs.	Percent deposits (400X)	Jet No.	Spinning time, hrs.	Percent deposits (400X)
1	102	5.50	1	102	1.90
2	102	3.70	2	102	1.60
3	300	4.20	3	282	1.70
4	300	3.40	4	300	1.40
5	300	3.10	5	300	4.20
6	300	5.10	6	300	3.60
7	300	3.50	7	300	4.00
8	300	5.00	8	300	2.80
	300	10.10	9	200	2.50
10	300	4.10	10	300	3.32
As received, average		4.80	As received, average		3.10
Average [1]		2.60	Average [1]		1.40

[1] Boiled 3 hrs. in methylene chloride.

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Fig. 2

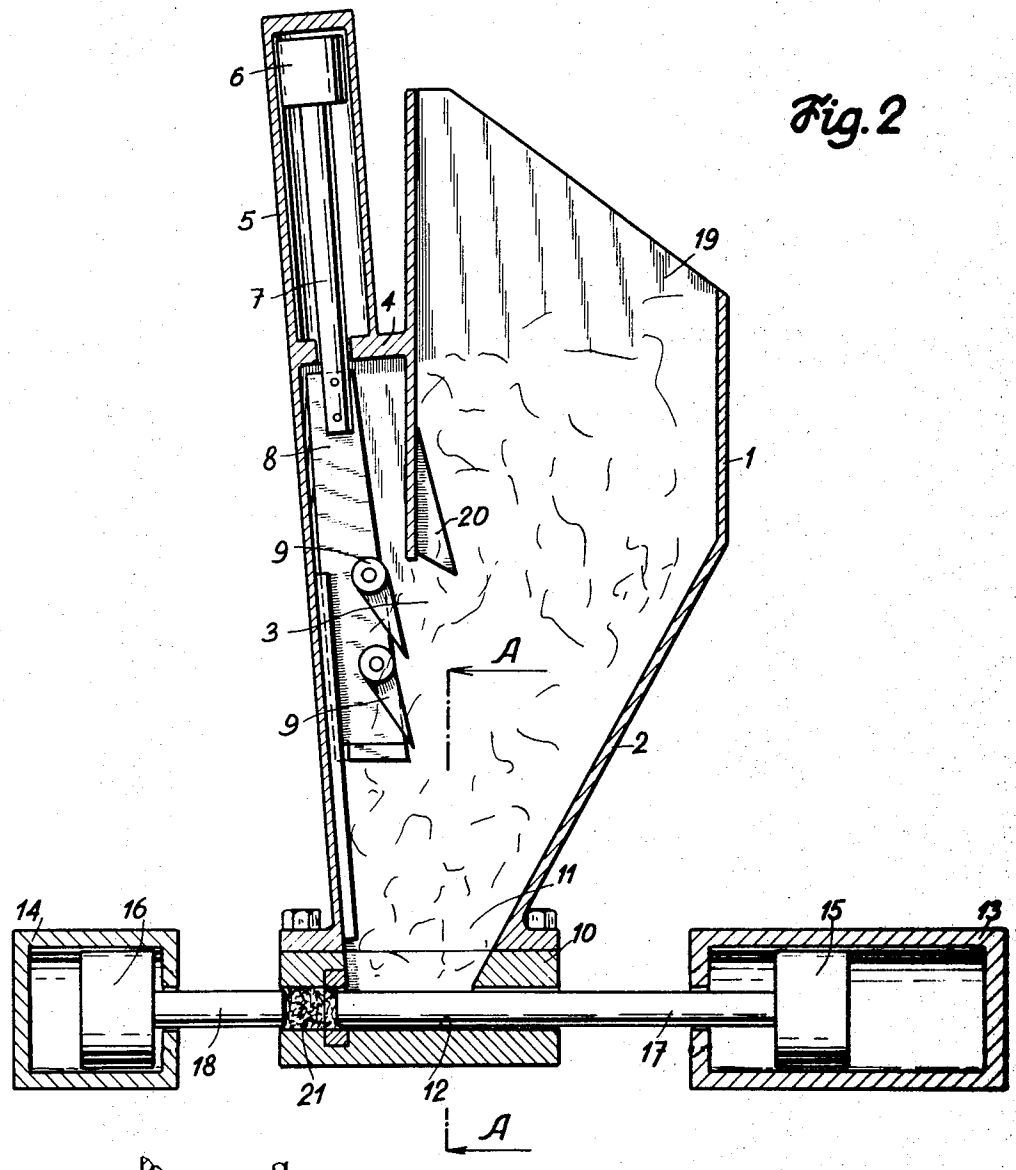
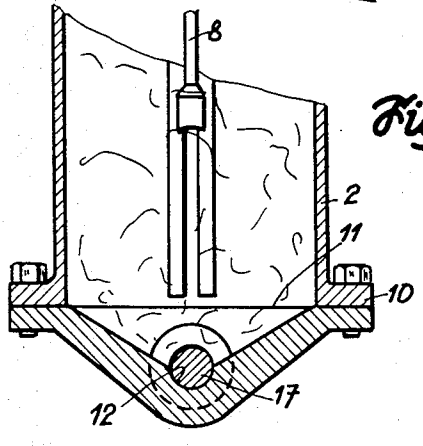


Fig. 2A



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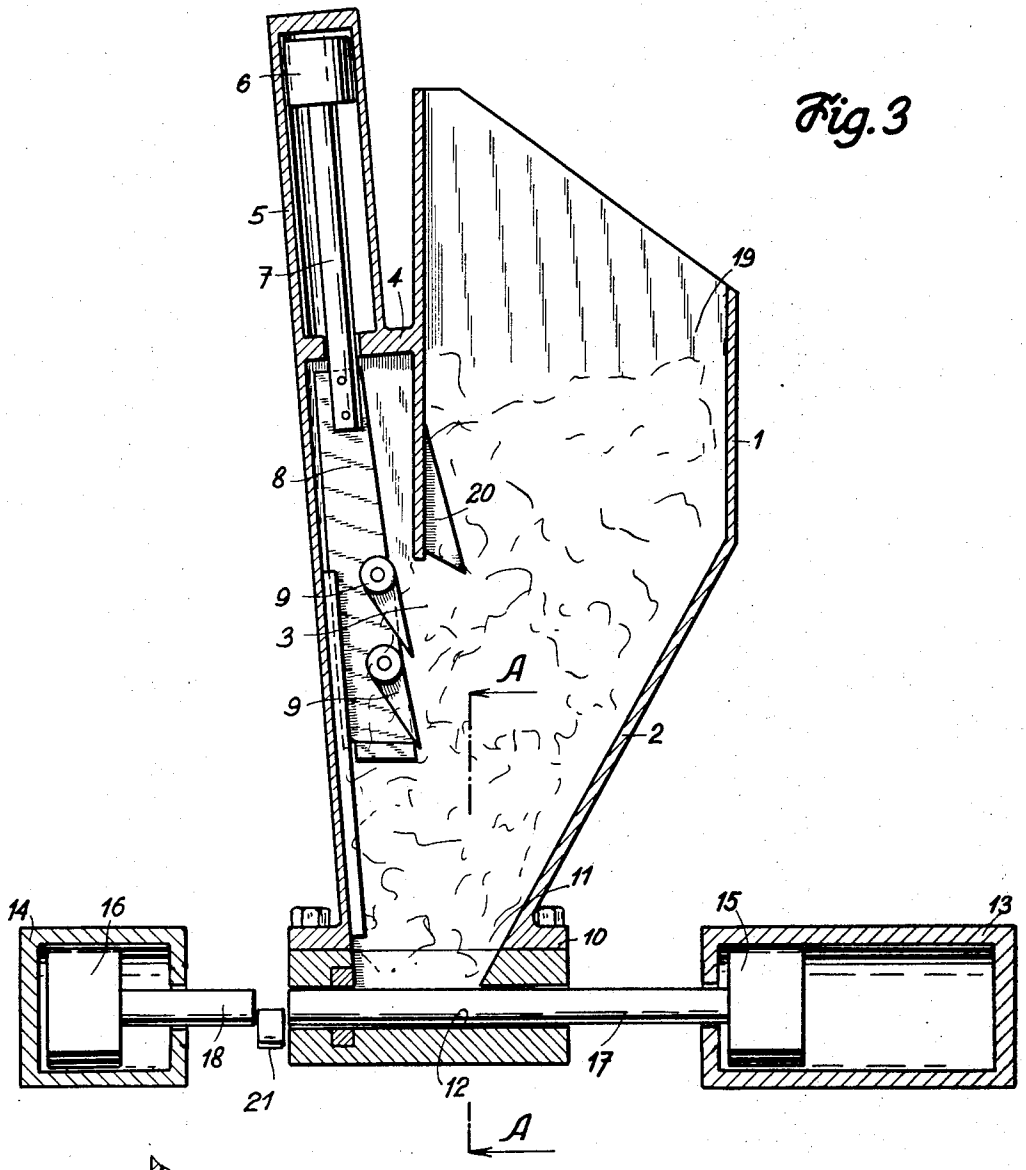


Fig. 3

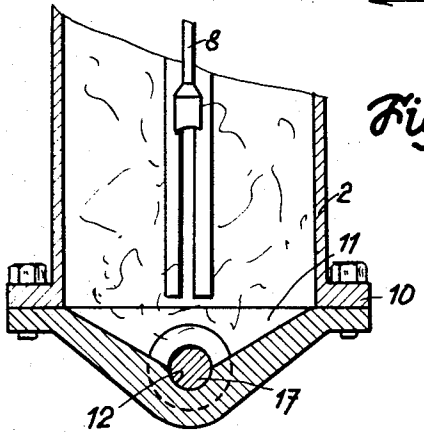


Fig. 3A

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APPARATUS FOR BRIQUETTING METAL CHIPS

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ABSTRACT OF THE DISCLOSURE

An apparatus for briquetting metal chips comprising a die member; a transverse channel passing through said die member, said channel being open at both ends, an inlet opening in said die member arranged at an angle to said channel and communicating therewith; a feed duct for receiving the chips to be processed, the said feed duct leading into said inlet opening; a piston forming a punch member and being normally disposed in said transverse channel of said die; abutment means for said piston; means for supporting said piston for movement in said channel in a direction opposite to said abutment means; ram means movable into the path of movement of metal chips fed through said feed duct and inlet opening, whereby the chips are forced into said transverse channel and are pressed into a briquette shape between said piston and abutment means when the piston is moved against the abutment means; and means for releasing the formed briquette from said channel.

BACKGROUND OF THE INVENTION

There are presently two methods available for recovering and shaping metal chips, particularly steel chips. In one of these methods the chips as formed are conveyed from the place of origin to the metallurgical plant where they are remelted in a blast furnace. Thus, pig iron is obtained from the material of the original steel chips.

This method leads to a substantial waste, the losses in the melting procedure being up to 60%. Another shortcoming of this method is the necessity for hauling the metal chips from the place of origin to the metallurgical plant which often involves a substantial distance and in addition the requirement to store the original irregularity shaped chips.

Another method comprises crushing the original irregular, for instance curled or curved chips in a crusher right at the place of origin. Usually, two crushing operations are required with an average chip length of about 2.5 cm. After crushing, the chips are then pressed into briquette shape by separate briquetting machines. Thereafter the remelting in a steel furnace takes place.

In this case the melting loss is usually not more than about 7%. This method also permits a comparatively easy storage of the original chips as well as of the briquettes and the shipment of the material usually involves only shorter distances. However, the drawback of this method is that the crushing operation is expensive because in the presently known types of crushing apparatus it can be done only at substantial rates of waste and failure.

A combination of a hopper, receiving chamber and die has also been proposed. However, with the presently known arrangement of this type, a regular feeding of the material in uniform amounts or doses has not been possible.

SUMMARY OF THE INVENTION

It is therefore one of the objects of the invention to provide a combined apparatus wherein the crushing of the original irregularity curled or curved metal chips as well as the formation of the final compact briquettes takes place in one and the same machine.

It is a further object of the invention to provide for this type of apparatus where a uniform and predetermined amount of feed into the die is effected and thus a predertemined amount of briquettes is produced.

The objects are met by an apparatus comprising a die member; a transverse channel passing through said die member, said channel being open at both ends, an inlet opening in said dies member arranged at an angle to said channel and communicating therewith; a feed duct for receiving the chips to be processed, the said feed duct leading into said inlet opening; a piston forming a punch member and being normally disposed in said transverse channel of said die; abutment means for said piston; means for supporting said piston for movement in said channel in a direction opposite to said abutment means; ram means movable into the path of movement of metal chips fed through said fed duct and inlet opening, whereby the chips are forced into said transverse channel and are pressed into a briquette shape between said piston and abutment means when the piston is moved against the abutment means; and means for releasing the formed briquette from said channel.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings illustrate an embodiment of the invention. More specifically,

FIG. 1, in cross section illustrates the apparatus of the invention wherein the ram is in the downward position and metal chips fed through the hopper and inlet opening have therefore been pushed into the die, the two pistons being shown in their initial position;

FIG. 1A is a detail of FIG. 1 along lines A—A;

FIG. 2 illustrates the same embodiment, likewise in cross-section in the position where the ram has been withdrawn from the die and inlet opening and the piston of the punch member has been advanced into the crushing position where it coacts with the opposed piston;

FIG. 2A is a detail of FIG. 2 along lines A—A there of;

FIG. 3 illustrates a similar cross-section of the same embodiment wherein the second piston **16**, **18** has been withdrawn to a position spaced from the end of the die channel so that the formed briquette can be released and dropped to the bottom to an outside receiving vessel (not shown); and

FIG. 3A is a detail of FIG. 3 along lines A—A.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to the drawings, the material is introduced through a hopper **1** which at its lower portion **2** is truncated and open towards one side as indicated at **3**. Attached to the hopper by means of a bracket **4** is in a cylindrical guide member **5** for a piston **6** which through a shank **7** carries a forward ram head **8**. Pivotally attached to the ram head are two blades **9** adapted for movement about a horizontal axis.

Preferably made in one piece with the guide member **5** and the hopper **1** is a die **10** which comprises an inlet opening **11** and a transverse channel **12** which at its central part communicates with the inlet opening and which

completely traverses the die so as to be open at its two ends.

13 indicates a cylindrical member which may be supported in any convenient manner (not shown) in which a piston 15 having a punch head 17 moves and 14 indicates a similar cylindrical member in which a similar but shorter piston 16 having a forward head 18 is movable.

The operation of the device is as follows:

The irregularly formed, for instance curved or curled metal chips 19 as they come from the place of origin are advanced by gravity through the hopper 1 and are directed by a metal blade or baffle plate 20 attached to the inner wall of the hopper. They then move into the path of the ram 8 which when moving downwards pushes the chips into the die inlet opening 11 and transverse channel 12 of the die.

It will be noted that the pivotally attached blades 9 in the downward position of the ram as shown in FIG. 1 have moved into an upwards extended position under the pressure of the material which is being pushed by the ram 8 into the die. The material thus acts against the underside of the blades which may be held in their extended position by means of a conventional stop (not shown). The metal chips are thus prevented from escaping upwards into the hopper when subject to the action of the ram 8.

As soon as the die channel 12 is filled the piston 15, 17 moves forward while the other piston 16, 18 remains stationary. The metal chips are thus caught between the two piston heads and a briquette 21 is formed due to the pressure of the piston 17 against piston 18. This position is indicated in FIG. 2.

As a next step, piston 16, 18 is withdrawn from channel 12. As will be noted, cylinder 14 and piston 16 are of comparatively short length. The length of withdrawal however, must be adequate to provide for a predetermined space between the piston head 18 and the head of piston 15, 17, which latter at this point is moved as shown in FIG. 3 towards the end of the transverse channel 12. The briquette 21 is thus expelled from the apparatus and may be collected in a convenient receptacle (not shown).

It will be understood that the relative distance of the piston heads in the crushing position will determine the transverse diameter of the individual briquettes. If desired, provision may be made for adjusting this distance as desired.

It will also be appreciated that throughout the feeding and compressing or punching step a reverse movement of the metal chips is counteracted both by the pivoted blades 9 provided on the ram head 8 and by the blade 20 provided at the inside of funnel 1.

Modifications of the device are of course possible without departing from the basic concept of the invention. For instance, while in the embodiment shown the piston 16, 18 is at rest during the punching operation itself, there could also be an opposite movement of both pistons. It furthermore, would not make any difference which piston is withdrawn from the transverse channel to permit the release of the formed briquette.

It will also be understood that the die may be of any desirable shape and in particular the transverse channel may be shaped as desired to obtain any convenient form of pressed metal block. The term briquette as used herein should therefore not be taken as a limitation to a specific form, but stands simply for a compressed and shaped form of chip.

It will also be understood that while conveniently the essential parts comprising the hopper 1, the guide 5 for the ram 8 and the die 10 are shown as made in one piece, this is not essential to the invention as long as the described cooperation of the parts is assured.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

I claim:

1. An apparatus for briquetting metal chips comprising a die member having opposite ends, a channel extending in longitudinal direction through said die member from one to the other of said ends thereof, and an inlet opening between said ends and communicating with said channel; a feed duct for receiving chips to be processed, said feed duct extending transversely to said channel and communicating at one end thereof with said inlet opening in said channel; a piston forming a punch member extending through one end of said die member into said channel; abutment means at the other end of said channel and normally closing said other end; means cooperating with said piston for moving the same in said channel from a rest position to one side of the inlet opening distant from said abutment means to an active position beyond the other side of said inlet opening; a ram extending substantially normal to the axis of said channel into said feed duct and having a front face substantially parallel to said axis; means connected to said ram for moving the latter, while said piston is in said rest position, from a withdrawn position distant from said die member to an advanced position in which said front face is moved into said inlet opening so as to force chips into the channel and to precompress the chips between said front face and the face portion of said channel opposite said inlet opening, whereby the thus precompressed chips in said channel will be finish compressed into briquette shape between said abutment means and said piston when the latter is moved from said rest to said active position; and means for releasing the thus formed briquettes from said channel.

2. The apparatus of claim 1, wherein the abutment means are in the form of a second piston disposed in said channel oppositely said piston of the punch member.

3. The apparatus of claim 2, wherein at least one of said pistons is retractable from said channel into a position spaced from the other end of said channel so as to permit expelling of the briquettes from said channel upon extreme forward movement of the other piston.

4. The apparatus of claim 1, wherein the ram is adapted to transverse said inlet opening of the die member.

5. The apparatus of claim 1, wherein the feed duct is in the form of a hopper, the hopper being truncated at its lower end and being laterally open at such end adjacent the said inlet opening and wherein the apparatus includes support means for said ram, the said support means being attached to said hopper to permit movement of the ram into said lateral opening of said hopper and the inlet opening of said die member.

6. The apparatus of claim 1 which includes blades laterally and pivotally atached to the ram so that the blades are adjacent said lateral opening of the hopper in the forward position of the ram, the pivot attcahment permitting movement of the blades from a retracted to an extended position depending on the side of the blades upon which the metal chips impinge, the blades thus moving into the extended position upon forward movement of the ram and retracting upon rearward movement of the ram.

7. The apparatus of claim 2, wherein one of the pistons is movable inwardly in said channel beyond said inlet opening and wherein the second piston is normally at rest in the said transverse channel at a place remote from the inlet opening during the compression step and is movable for full withdrawal from said transverse channel for the release of the briquette after formation.

8. An apparatus for briquetting metal chips comprising a die; a transverse channel passing through said die, said channel being open at both ends; an inlet opening in said die and communicating with said channel between the ends thereof; a hopper associated with said die and being laterally open at its lower portion, said hopper being adapted for receiving the chips to be processed and to lead them into said inlet opening of said die; a ram; means for supporting said ram for movement into said open end of said hopper and said inlet opening of said die; blades laterally and pivotally attached to said ram at the side facing said hopper and movable from a retracted to an extended position depending upon the side of the blades upon which the metal chips impinge to thus move into the extended position upon forward movement and to the retracted position upon rearward movement of the ram; two opposed pistons normally disposed in said transverse channel of the die; and means for moving said pistons, one of said pistons being in the form of a punch member and being movable inwardly across said inlet opening, the other piston being normally at rest in the transverse channel remote from said inlet opening and being movable outside of said channel into a position spaced from the respective channel end, whereby metal chips fed through said hopper and inlet opening into said transverse channel by means of said ram are pre-

compressed by the latter in said channel and then finish pressed into a predetermined compact shape between said pistons when the pistons forming the punch member is moved against the other piston and whereby the thus formed briquettes are expelled from said channel upon forward movement of said punch member toward the opposite end of said channel and simultaneous withdrawal of the other piston from said channel into said spaced position.

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U.S. Cl. X.R.

18—5, 16