

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
6 February 2003 (06.02.2003)

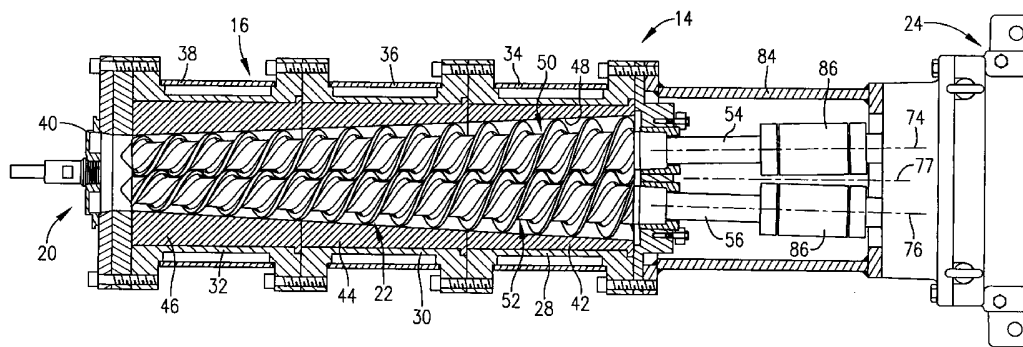
PCT

(10) International Publication Number  
**WO 2003/009982 A3**

- (51) International Patent Classification<sup>7</sup>: **B29B 7/20**, A21C 1/06
- (74) Agent: **COLLINS, John, M.**; Hovey Williams LLP, Suite 400, 2405 Grand Boulevard, Kansas City, MO 64108 (US).
- (21) International Application Number: PCT/US2002/017224
- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.
- (22) International Filing Date: 31 May 2002 (31.05.2002)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
09/912,144 24 July 2001 (24.07.2001) US  
10/068,181 5 February 2002 (05.02.2002) US
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- (71) Applicant (*for all designated States except US*): **WENGER MANUFACTURING, INC.** [US/US]; 714 Main Street, Sabetha, KS 66534 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (*for US only*): **HAUCK, Bobbie, W.** [US/US]; 603 Virginia, Sabetha, KS 66534 (US). **WENGER, Lavon, G.** [US/US]; 1524 Centennial Drive, Sabetha, KS 66534 (US).
- Published:  
— with international search report
- (88) Date of publication of the international search report:  
4 March 2004

[Continued on next page]

(54) Title: TWO SCREW EXTRUDER WITH CONICAL NON/PARALLEL CONVERGING SCREWS



(57) Abstract: An improved twin screw extruder device (14) is provided which is capable of producing a wide variety of high quality extrudates having greatly varying final properties, without the need for extensive machine. The extruder (14) includes a barrel (16) together with a corotating twin screw assembly (22). The assembly (22) is made of a pair of screws (50,52) having central, tapered shafts (54,56) equipped with outwardly extending helical flighting (58,60); the screws (50,52) are non-parallel and are positioned so that the flighting (58,60) thereof is intercalated along the length of the screws (50,52). The flighting is of specialized configuration and tapers along the length of screws (50,52) preferably at an angle of taper different than that of the shafts (54,56); moreover, the width of the outer flighting surfaces (70,72) increases along the length of the shafts (54,56). This screw geometry defines a series of alternating upper and lower close-clearance high-pressure nip areas (78) defined by the flighting (58,60) which serves to propel an extrudable forwardly towards the outlet end (20) of the barrel (16). However, passageways (80) and kneading zones (82) are also defined between the screws (50,52), which assures full mixing, shearing and cooking of the material. The extruder device (14) is capable of producing high density sinking aquatic feeds as well as expanded, low density products merely by changing the rotational speed of the screws (50,52) together with appropriate temperature control. In another embodiment, fluid extraction extruder (138) is provide having a specialized extruder head (140) including an outer shell (144) and an inner, elongated, slotted sleeve (152).

WO 2003/009982 A3



---

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**INTERNATIONAL SEARCH REPORT**

International application No.  
PCT/US02/17224

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC(7) : B29B 7/20; A21C 1/06  
 US CL : 366/85, 89; 425/208, 245  
 According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**  
 Minimum documentation searched (classification system followed by classification symbols)  
 U.S. : 366/85, 88, 89, 83, 84, 323 ; 425/208, 205, 204, 209, 145

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---	US 4,247,206 A (ZAHRADNIK) 27 January 1981, see entire document.	9-13, 15-26, 28-35, 37-48, 50-52, 86, 89-92
Y		----- 52-85
Y	US 5,783,240 A (WENGER et al) 21 July 1998, see entire document.	52-85
Y	US 4,875,847 A (WENGER et al) 24 October 1989, see entire document.	52-85

Further documents are listed in the continuation of Box C.  See patent family annex.

* Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means		
"P" document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search  
28 August 2002 (28.08.2002)

Date of mailing of the international search report  
**03 OCTOBER 2002**

Name and mailing address of the ISA/US  
 Commissioner of Patents and Trademarks  
 Box PCT  
 Washington, D.C. 20231  
 Facsimile No. (703)305-3230

Authorized officer  
 Tony G Soohoo  
 Telephone No. (703) 308-0661

DEBORAH THOMAS  
 PARALEGAL SPECIALIST *pat*

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US02/17224

## Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claim Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claim Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3.  Claim Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:  
Please See Continuation Sheet

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
  2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
  4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
- Remark on Protest**  The additional search fees were accompanied by the applicant's protest.  
 No protest accompanied the payment of additional search fees.

# INTERNATIONAL SEARCH REPORT

PCT/US02/17224

## **BOX II. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING**

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

- I. Claims 1-92, drawn to an extruder and method with particulars to a twin screw and taper geometry.
- II. Claims 93-105, drawn to an extruder and method with particular extruder head, sleeve and slot geometry.

The species listed above do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, the species lack the same or corresponding special technical features for the following reasons: The Groups lack the same corresponding respective features of taper geometry and extruder head geometry.