In the Matter of

CERTAIN DRILL POINT SCREWS FOR DRYWALL CONSTRUCTION

Investigation No. 337-TA-116

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United States International Trade Commission / Washington, D.C. 20436

UNITED STATES INTERNATIONAL TRADE COMMISSION

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COMMISSION ACTION AND ORDER

Introduction

The United States International Trade Commission has concluded its investigation under section 337 of the Tariff Act of 1930 (19 U.S.C. § 1337), of alleged unfair methods of competition and unfair acts in the unauthorized importation of certain drill point screws for drywall construction into the United States, or in their sale by the owner, importer, consignee, or agent of either, the alleged effect or tendency of which is to destroy or substantially injure an industry, efficiently and economically operated, in the United States. The Commission's investigation concerned allegations that drill point screws for drywall construction imported or sold by respondents Kabushi Kaisha Yamashina Seikosho, Kyoto-Shi, Hyoto-Fu, Japan; J. Robert Agencies, Ltd., Vancouver, British Columbia, Canada; and Yama-Fas, Inc., South San Francisco, California, are covered by claims 1-6 of U.S. Letters Patent 3,463,045 (hereinafter the '045 patent). The '045 patent is owned by complainant Illinois Tool Work, Inc. (ITW) of Chicago, Illinois.

This Action and Order provides for the final disposition of investigation No. 337-TA-116 by the Commission. It is based upon the Commission's unanimous

determination, made in public session at the Commission meeting of February 17, 1983, that there is no violation of section 337.

Action

Having reviewed the record compiled and information developed in this investigation, including (1) the submissions filed by the parties, (2) the transcript of the evidentiary hearing before the administrative law judge (ALJ) and the exhibits which were accepted into evidence, (3) the ALJ's recommended determination, and (4) the arguments and presentations made at the Commission's public hearing on January 18, 1983, the Commission, on February 17, 1983, unanimously determined that, with respect to the respondents in investigation No. 337-TA-116, there is no violation of section 337 of the Tariff Act of 1930 in the importation into and sale in the United States of certain drill point screws.

Order

Accordingly, it is hereby ORDERED THAT--

1. Investigation No. 337-TA-116 is terminated as to all issues and all respondents;

2. The Secretary shall serve copies of this Action and Order and the Commission opinions in support thereof upon each party of record to this investigation and upon the U.S. Department of Health and Human Services, the U.S. Department of Justice, the Federal Trade Commission, and the U.S. Customs Service; and

3. The Secretary publish notice of this Action and Order in the Federal Register.

By order of the Commission.

Kenneth R. Mason
Secretary

Issued: March 3, 1983

COMMISSION OPINION

Procedural Background [1/]

Illinois Tool Works, Inc., Chicago, Illinois, (hereinafter ITW) filed a complaint with the Commission on January 20, 1982, alleging violations of section 337 of the Tariff Act of 1930 and seeking both a permanent exclusion order and a cease and desist order. [2/] The Commission instituted an investigation on February 18, 1982, to determine whether there is a violation of subsection (a) of section 337 in the unauthorized importation of certain drill point screws for drywall construction into the United States, or in their sale, by reason of alleged direct infringement by said screws of claims 1-6 of U.S. Letters Patent 3,463,045 (hereinafter the '045 patent), the effect or tendency of which is to destroy or substantially injure an efficiently and economically operated domestic industry. A notice of investigation was published in the Federal Register on March 3, 1982. [3/] The respondents named in this investigation were Gyplok and Kabushi Kaisha Yamashina

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1/ The following abbreviations are used in this opinion: ALJ = Administrative Law Judge; IA = Commission investigative attorney; RD = ALJ's recommended determination; CX = complainant's exhibit; RX = respondents' exhibit; RPX = respondents' physical exhibits; CPX = complainaint's physical exhibits; ET = transcript of evidentiary hearing before ALJ; HT = transcript of hearing before the Commission held on January 18, 1983; FF = ALJ's finding of fact; CL = ALJ's conclusion of law; CB = complainant's Pre-Hearing Brief to the Commission; RB = respondents' Brief on Violation.

2/ In its prehearing brief on remedy, bonding and the public interest, complainant requested the issuance of both a permanent exclusion order and a cease and desist order. The cease and desist order was sought for the interim period prior to the issuance of the exclusion order. The complainant withdrew this request at the Commission hearing. HT 152.

3/ 45 F.R. 9113-14 (March, 1982).

Seikosho. On June 25, 1982, upon the recommendation of the ALJ, the Commission amended its notice of investigation to correct the name of respondent Gyplok to "Kabushi Kaisha Yamashina Seikosho d/b/a/Gyplok" and to add J. Robert Agencies, Ltd. and Yama-Fas, Inc. as respondents in the investigation. 4/

The evidentiary hearing before the ALJ commenced on September 21, 1982. Appearances were made by complainant ITW, respondents Kabushi Kaisha Yamashina Seikosho (hereinafter Yamashina), J. Robert Agencies, Ltd., and Yama-Fas, Inc., and the IA. On November 29, 1982, the ALJ issued an RD in which he found no violation of section 337.

The Commission held a hearing on the RD and on remedy, the public interest, and bonding on January 18, 1983. Appearances were made by complainant ITW, respondents Yamashina, J. Robert Agencies, Ltd., and Yama-Fas, Inc., and the IA. On February 17, 1983, the Commission unanimously determined that there is no violation of section 337 based on a finding of no infringement of the patent in issue and a finding of no injury. 5/ In this negative determination, we discuss all issues of violation. Having found no violation, we do not reach the issues of remedy, the public interest, and bonding.

4/ 47 F.R. 28479 (June, 1982).

5/ Commissioner Stern reaches all the issues of violation in conformity with the language in Coleco Industries, Inc. v. U.S. International Trade Commission, 573 F.2d 1247 (CCPA 1978).

The Product

The subject of this investigation is a forged drill point screw which is utilized as a fastener in several applications, including drywall construction, the automotive industry, and the appliance industry. Those screws manufactured by complainant ITW and its licensees are marketed under several trade names, according to the nature of their use. Those screws used in drywall construction are commonly known as "S-12" screws, while those screws employed in other industrial applications are generally known as "TEKS" fasteners. The screws imported and sold by respondents are known as "Jet Drive," or "JD" screws, and are used for drywall construction.

The '045 Patent

The patent in issue, the '045 patent, 6/ was issued on August 26, 1969, to the named inventor Arthur W. Prescott. The patent was assigned to ITW on June 24, 1966. The '045 patent discloses a drilling screw having a forged drilling tip with features that are intended to provide a screw that has a relatively strong and rugged entering end, or drilling tip portion, and relieved, well-supported and highly efficient cutting or drilling edges.

Violation

I. Patent validity

We concur with the ALJ and find that the '045 patent is valid. 7/ Further, we note that respondents have conceded the issue of validity in these proceedings. 8/

6/ The patent is set forth in its entirety as Attachment A.
7/ CL 2, RD at 150; FF 12-64, RD at 7-64; RD 71-91.
8/ RB at 1; HT 133-134.

I. Infringement

Complainant has alleged that the drill point screws imported by respondents are infringing claims 1-6 of the '045 patent, either literally or under the doctrine of equivalents. To prove literal infringement, one or more claims of the '045 patent must read on the structure of the Yamashina screw. 9/ Complainant only briefed and argued infringement of claim 1, the sole independent claim involved. 10/

Respondents' defense with regard to infringement focuses on three elements of claim 1. Respondents argue that the Yamashina screws do not infringe the '045 patent because (1) they do not have surfaces corresponding to the '045 patent flute surfaces which traverse a second plane; (2) they do not have a web structure which corresponds to the web provided for in the '045 patent; and (3) they do not have end surfaces corresponding to the end surfaces provided for in the '045 patent which have a convex configuration and varying radii of curvature greater than the radius of the body of the screw. 11/

The ALJ found that there is no literal infringement of the '045 patent by the Yamashina screws. We find, as did the ALJ, that the Yamashina flute surfaces do not traverse a second plane containing the longitudinal axis of the screw. Our conclusion is based on the reasoning of the ALJ, our own

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9/ See Tate Engineering Co. Inc. v. United States, 477 F. 2d 1336 (Ct. Cl. 1973); Autogiro Co. of America v. United States, 384 F.2d 391 (Ct. Cl. 1967); 4 Chisum, Patents, § 18.04[4].

10/ See Attachment A.

11/ RD at 92; RX-3 at 21-22.

observation of the physical and photographic evidence, [12] and the testimony of both complainant's and respondents' expert witnesses. [13] [14]

The question of whether the flute surfaces of the Yamashina screw traverse a second plane containing the longitudinal axis of the screw and the question of whether it has a web within the meaning of claim 1 of the '045 patent are related. Complainant's expert testified that the presence of a web requires that the flute surfaces traverse the second plane of the screw. [15] With this testimony, and in light of the determination that the Yamashina flute surfaces do not cross the second plane, it is apparent that the web as contemplated under the '045 patent does not exist in the Yamashina screw. The nonexistence of this web in the Yamashina screw can also be demonstrated independently by the weight of the evidence.

Claim 1 of the '045 patent teaches:

> a narrow web between said flute surfaces at said free terminal end and presenting a narrow tip edge for initial engagement with a workpiece during drilling operation, said cutting edges including portions disposed substantially in a common plane and traversing said web portion and defining opposite side corners of said tip edge.

12/ RPX 3-7; CPX 1-5; CX 12, 14-18, 80, 103; RX 174; RPX 9, 11; CPX 17-18, and RX 3 (Figs. 1-12).

13/ Respondents' expert witness is President and Director of Almay Research and Testing Corporation, Los Angeles, California, and a professional engineer with over 37 years of experience in the field of mechanical fasteners.

14/ Complainant's expert witness was the Plant Manager of complainant's Screw Division, and has 24 years of experience in the screw industry. He also participated in the early development and testing of complainant's screw.

15/ ET 244.

The patent specification [16] indicates that an important object of the invention is to provide a novel drilling screw which has a relatively strong and rugged entering end, or drilling tip portion, as follows:

> This narrow web or tip portion . . . provides the screw with a strong well-supported yet relatively thin or sharp point for facilitating entry into a workpiece during a drilling operation. [17]

For the claims of the '045 patent to read on the allegedly infringing Yamashina screw, the tip portion of the Yamashina screw must facilitate entry into the workpiece during drilling. However, the information indicates that the Yamashina screw has been designed as a relatively pointed screw that initiates entry by punch pointing. [18] In contrast to the patented screw web which is part of the design and is forged within the die cavities of the patented screw, the web-like material on the Yamashina screw is metal (called flashing) that has flowed outside the designed portion of the screw during forging and does not function as the web in the patented screw does. [19]

The third element of claim 1 in issue is whether the Yamashina screw is "relieved behind said cutting edge with said end surfaces having a convex configuration and varying radii of curvature greater than the radius of said

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16/ Patent claims are to be construed in light of the specification. United States v. Adams, 383 U.S. 48, 49 (1966).

17/ CX 1, Col. 3, 34-39.

18/ This is similar to what was contemplated under the German Lenne self-drilling screw, RX-51, cited by Kiyoshi Morita, Director of Research and Development for Yamashina, RX-1 at 2.

19/ Brenner, ET 18-19; Friedland, ET 275, 280-281; RD at 97-98, 114-115.

body." [Emphasis supplied.] The Yamashina screw has end surfaces with a convex configuration, but does not possess varying radii of curvature greater than the radius of the body. While the portions of the Yamashina screw corresponding to the end surfaces of claim 1 have a convex configuration and varying radii of curvature, the evidence as a whole is insufficient to show varying radii of curvature "greater than the radius of the body." 20/

In addition to the allegations of literal infringement, complainant argues that respondents' screw infringes the '045 patent under the doctrine of equivalents. However, we find that the doctrine of equivalents does not apply in this investigation. The drill screw art appears to be a crowded art and thus the '045 patent is not entitled to a broad range of equivalents. 21/ A showing of equivalence requires information showing that the Yamashina screw employs substantially the same means to achieve substantially the same result in substantially the same way as the patented screw. 22/

While the Yamashina screw achieves the same result as the patented screw, it does not utilize substantially the same means to achieve that result in substantially the same way. More specifically, the Yamashina screw flashing does not function in substantially the same way as the web of the patented screw; entry to the working surface is effected with the Yamashina screw by a

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20/ See CX 18 and RX 174, which are enlarged photographs of sections of the ITW screw and of the Yamashina screw, respectively, taken perpendicular to their cutting edges and longitudinal axes.

21/ Tate, supra at 1340.

22/ Graver Tank Mfg. Co. v. Linde Co., 339 U.S. 605, 609 (1968).

punching technique in contrast to the cutting or peeling action of the patented web. Furthermore, as set forth in the RD, 23/ the offset half-cones of the Yamashina screw are not equivalent to the means for relief provided by the patented screw. Thus, the Yamashina screw is not equivalent to the patented screw.

III. Importation and sale.

We conclude that respondents have engaged in the importation and sale of the screws subject to this investigation in the United States and adopt the findings and conclusions of the ALJ in the RD with regard to the questions of importation and sale. 24/ Furthermore, respondents have stipulated that they are engaged in the importation and sale of the subject screws. 25/

IV. Industry

A. Definition.

An issue in this investigation is whether the domestic industry should be defined as those facilities producing the patented screws for all purposes or for drywall construction only. 26/ We find it appropriate in this investigation to limit the scope of the domestic industry to those domestic

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23/ RD at 116.
24/ RD at 121, FF 122-128.
25/ Prehearing conference transcript 26-27, 48 (September 20, 1982).
26/ RD 122-130.

facilities producing the patented drill point screws for drywall construction. 27/ 28/ Therefore, the domestic industry consists of those

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27/ Our definition of domestic industry is consistent with that advocated by complainant. See Complaint of Illinois Tool Works Inc. filed with the Commission on January 20, 1982.

28/ Commissioner Stern finds that the domestic industry in this investigation consists of the domestic operations of the complainant and its licensees dedicated to the exploitation of the patent in issue. The majority in reaching its definition of industry has relied heavily on the decision of the Commission's majority in Headboxes. I find the following statement from my views in Headboxes to be equally applicable to this investigation:

> The novel definition adopted by the majority in this case focuses on the imported article and then, through a like product analysis, limits the definition of the industry to a portion of the exploitation of the patents in issue. This takes what was an already artificial and rarefied definition of the term "industry"--which was adopted to make a patent-based jurisdiction viable under section 337 -- and extends it beyond any reasonable interpretation.

Certain Headboxes and Papermaking Machine Forming Sections for the Continuous Production of Paper, and Components Thereof, Dissenting Opinion of Commissioner Paula Stern, Investigation No. 337-TA-82 (1981) at 10. In fact, the majority's action in Headboxes led to a definition of industry which consisted of all the exploitation of the two patents in issue in tandem. Here we have one patent which is being used to produce one product for different applications. So this is the first time that the Commission has moved to an industry definition narrower than the exploitation of the patent when there has been only one patent involved.

In Certain Methods for Extruding Plastic Tubing, Investigation No. 337-TA-110 (1982) the Commission followed my line of reasoning in Headboxes and returned to the Commission's traditional exploitation of the patent analysis. In fact, the situation in Plastic Tubing was very close to the one we face in this investigation. The complainant and its licensee were producing under the patents for what were predominantly separate markets--industrial and consumer. The subject imports were for the industrial market. The Commission found the domestic industry consisted of the exploitation of the patent rights in issue and did not limit its definition to only production for the industrial market. It seems to me that better policy would dictate following the Plastic Tubing analysis rather than departing from it as the majority has done in this investigation.

The majority in this investigation has cited another investigation to reinforce its position saying that the realities of the marketplace (Continued)

facilities of complainant's Buildex and Shakeproof Divisions [29/] devoted to the production of S-12 screws for drywall construction, and those portions of the facilities of ITW's licensees---Elco, National Lock, Parker-Kalon, Central, and Continental Screw (Midland)---devoted to the production, pursuant to the '045 patent, of forged self-drilling screws for drywall construction.

The facilities of complainant are segregated according to the intended use of the screws, i.e., for drywall construction or for other industrial applications. The Buildex Division of complainant ITW is responsible for the marketing and the manufacturing of all but 5-6 percent of ITW's production of the subject drill point screws, [30/] the patented screws used in drywall

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28/ (Continued)
justify its perspective. Certain Apparatus for the Continuous Production of Copper Rod, Investigation No. 337-TA-52 (1979). However, in Copper Rod the "realities of the marketplace" principle was enunciated to define an industry broader, not narrower, than that which would have been reached by simple application of the exploitation of the patent principle.

Even if there is a compelling legal argument to look for an industry narrower than the exploitation of the patent, it is not possible to sustain such a definition in this investigation because of the data available. A large portion of the information on this industry is before us only in the form of royalties paid to the complainant by its licensees. These royalties are not broken down between drywall and non-drywall uses. The complainant and the five licensees producing for drywall uses also produce for other uses, and there are no restrictions on the licensees limiting production to one use or the other. Moreover, the division of the complainant producing primarily non-drywall screws also produces 5-6% of complainant's drywall screws.

29/ The Shakeproof Division also produces and markets the patented screws intended for non-drywall applications.

30/ The Shakeproof Division manufactures this minimal amount at its Elgin plant. RD at 128, FF 162.

construction. Yamashina produces for exportation to the United States only drill point screws for drywall construction. 31/

The record indicates that it is difficult for drywall screw manufacturers to divert facilities to the production of screws for use in the automobile or appliance industries. 32/ For example, a substantial amount of time, effort, and investment directed to the retraining of personnel and conversion of machinery would be required in order to convert the Buildex facility to the manufacture of non-drywall screws. 33/

The issue of defining the domestic industry more narrowly than the full scope of the subject patent was first raised in Certain Headboxes and Papermaking Machine Forming Sections for the Continuous Production of Paper and Components Thereof. 34/ We find Headboxes to be persuasive precedent for limiting the scope of the domestic industry to the facilities producing one of the two types of products covered by the '045 patent. In Headboxes, two patents were involved. One patent covered the apparatus used in the manufacture of single-ply paper. The second patent used some of the inventive concepts of the first patent in the production of multi-ply paper. Some of the inventive concepts of both patents were necessary to produce the multi-ply headboxes. The only allegedly infringing product being imported into the United States was the multi-ply headbox. In deciding that the domestic

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31/ FF 274. Yamashina's international marketing director testified that Yamashina had considered producing screws to compete with the TEKS screw but decided it was too difficult to enter the U.S. automobile and chassis market. Kamematsu, CX. 47, 30.

32/ RD at 125; FF 163-166.

33/ RD at 126; FF 164.

34/ Inv. No. 337-TA-82, USITC Pub. No. 1138 (April, 1981).

industry consisted of only those facilities producing multi-ply headboxes, the Commission stated:

> Even though single-ply headboxes are produced in accordance with one of the patents in issue, our focus under section 337 in patent cases is on injury caused by infringing imports to the domestic industry producing articles, covered by the patent, which compete with the subject imports. Thus, we cannot look just at the domestic facilities devoted to the production of all headboxes made in accordance with the '269 and '593 patents. To do so would not focus on the actual point at which the infringing imports have an adverse impact. Rather, we must identify specifically that portion of complainant's facilities which produces articles under the patents in suit and which is adversely affected by the infringing imported articles--namely, in this case, the complainant's production facilities for multi-ply headboxes. Upon that segment only should we assess the economic impact which the unauthorized importations and sales have on the legal monopoly of the patent holder. (Headboxes at 29). 35/

Respondents have argued that Certain Methods for Extruding Plastic Tubing 36/ is a more recent precedent which conflicts with the Headboxes methodology of defining the scope of the domestic industry. We disagree. In Plastic Tubing, the two domestic producers, Dow and Minigrip, produced for different markets, i.e., the consumer and industrial markets, respectively. There the Commisson found it appropriate to include both in defining the scope of the domestic industry and to assess the impact of imports accordingly. The Commission noted that Dow sold predominantly, but not exclusively, to the consumer market and that Dow's licensing agreement with complainant Minigrip did not preclude Dow from selling in the industrial market. 37/ The ALJ in

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35/ See also Certain Apparatus for the Continuous Production of Copper Rod, Inv. No. 337-TA-52, Pub. No. 1017 (1979), where the Commission indicated that it examines the "realities of the marketplace" in determining the scope of the domestic industry.

36/ Inv. No. 337-TA-110, USITC Pub. 1287 (1982).

37/ Plastic Tubing at 10.

that investigation concluded that there was an overlap between those markets, citing the licensing agreement and Dow's sale of bags purchased from Minigrip to "consumer food packers or processors" and the "spill-over market." In Plastic Tubing, a broad definition of industry to include facilities producing plastic bags for both the consumer and industrial markets was warranted because of competition, both actual and potential, between Dow and imports in the industrial market. This was not the situation in Headboxes where the product being imported, only multi-ply headboxes, was not competing with both products manufactured domestically under the patents in issue. Thus, the focus of Headboxes, Plastic Tubing, and the instant investigation is "on the actual point at which infringing imports have an adverse impact." 38/

B. Efficient and economic operation

We find that the domestic industry in this investigation is efficiently and economically operated. Although the record is limited with regard to complainant's licensees, there is ample evidence on the record that complainant itself is efficiently and economically operated. 39/

The information on the record indicates that ITW's plants are equipped with modern equipment; and that ITW has made major investments in research and development of its Buildex Division products since the mid-1960's. 40/ Further, the existence of a successful quality control program is demonstrated

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38/ Headboxes, supra at 29.
39/ The complainant represents nearly one-third of the domestic industry. RX 2 at 14.
40/ FF 194.

by complainant's reputation for a premium quality product. 41/ Separate space and facilities are maintained for the production of the S-12 screws; 42/ a successful sales campaign is demonstrated by a substantial increase of the value and quantity of the Buildex Division's sales between 1977 and 1981; 43/ and a sustained profitable operation is supported by an increase in ITW's profits on a variable margin basis in 1981 over 1977, after adjusting for inflation. 44/ We note also that respondents have stipulated to the efficient and economic operation of the complainant 45/ and declined to argue that the industry concerned in this investigation was not efficiently and economically operated. 46/

V. Injury

We determine that there is no injury or tendency to injure the domestic industry by reason of the importation and sale of respondents' screws in the United States. 47/ Specifically, we find that complainant did not meet its

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41/ Since ITW refuses licenses to companies which cannot produce screws of sufficient quality, it can be inferred that there is quality control among the licensees.

42/ FF 133.

43/ FF 208, 209.

44/ FF 237.

45/ Prehearing Conference Transcript at 27 (September 20, 1982).

46/ CX 89 at 10-11, Answer to ITW's Fourth Set of Interrogatories, dated August 18, 1982.

47/ Commissioner Stern notes that the injury analysis for an industry defined by usage in drywall construction is valid for the industry she has determined to exist in this investigation. See supra, note 28. There are no imports of screws allegedly produced under the subject patent for uses other than drywall construction. Thus, she is assessing the impact of the same imports on a broader industry. The weakness in complainant's proof that the alleged injury to the domestic industry was caused by importation of respondents' allegedly infringing screws was created by the existence of noninfringing imports in the market and the existence of other economic factors such as the current economic recession as an explanation for any problems being faced by the industry.

burden of proof in establishing either effect or tendency to substantially injure or that the subject imports are the cause of any such injury. 48/ The evidence on the record concerning injury is conflicting. There are some indications that the industry is experiencing financial difficulties but there is also information concerning areas of stability and improvement. As noted by the ALJ, 49/ the portion of the domestic industry represented by the licensees producing drill point screws for drywall construction is limited because of their lack of participation in these proceedings. Thus, while our injury analysis would ordinarily focus on injury to the licensees as well as to the patent holder, our analysis of injury to the licensees in the instant investigation is limited because of the paucity of evidence on injury to that portion of the domestic industry represented by them.

48/ Commissoner Stern notes that a finding that respondents' screws were infringing complainant's screws is insufficient to prove that there is a violation of section 337. The injury requirement of the statute is separate and distinct from the unfair act requirement and requires independent proof. See Spring Assemblies and Components Thereof, and Methods for Their Manufacture, Inv. No. 337-TA-88, (1981); PTFE Tape, Inv. No. 337-TA-4 (1976) (Opinion of Commissioners Bedell, Moore, and Parker); In the Ear Hearing Aids, T.C. Pub. No. 182 (1966); Sphygmomanometers, T.C. Pub. No. 457 (1972). Commissioner Stern noted in Spring Assemblies that:

> An attempt to relate a finding of patent infringement to a finding of "the effect or tendency . . . to substantially injure" is clearly not intended by the statute. This Commission has the obligation to make a judgment as to the causal relationship between the subject imports and any substantial injury to a domestic industry based on the reality demonstrated by the facts on the record and not an a per se analysis based on the same facts establishing the unfair act.

Spring Assemblies at 44, n. 37.

49/ RD at 140.

Factors the Commission has considered in reaching the injury determination include among other things: (1) lost sales; (2) underselling; (3) volume of imports; (4) decreased employment in the domestic industry and excess domestic production capacity; (5) foreign capacity to increase imports; and (6) whether, in the absence of an exclusion order, the imported products would capture an increasing share of the U.S. market. 50/ Complainant has alleged that the domestic industry is entitled to the 14 percent of the market which respondents have taken during the period under consideration and claims that this equates to a significant sum in lost revenue. 51/

To emphasize its allegations of lost sales, complainant indicated that respondents' sales have been to large customers of complainant and that one of complainant's licensees has returned a leased machine used to make the patented screw because of reduced sales. 52/ However, the record indicates that respondents have not taken away any of complainant's customers. Complainant's two largest customers buy all of their drywall screws exclusively from complainant. With regard to the five customers that complainant alleges have been lost, 53/ the record indicates that one was a mere prospect and not a regular customer; 54/ one purchased very few screws from respondents; 55/ one purchases approximately 100 percent of its screws

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50/ Convertible Game Tables, Inv. No. 337-TA-2 (1976); Certain Reclosable Plastic Bags, Inv. No. 337-TA-22 (1978); Certain Molded Golf Balls, Inv. No. 337-TA-35 (1978); Certain Roller Units, Inv. No. 337-TA-44 (1979); Certain Thermometer Sheath Packages, Inv. No. 337-TA-56 (1979).
51/ CB at 67.
52/ CB at 68.
53/ This is a minimal number out of a total number of distributors used by complainant.
54/ FF 217.
55/ FF 218.

from complainant; 56/ one became involved in a financial dispute with complainant and was told to find another supplier; 57/ and the fifth customer purchases from respondents as a second source of supply. 58/ Futhermore, the record does not adequately link the returned machine to respondents' activities. 59/ Complainant then projects Yamashina's increased market share into the future which, according to complainant's calculations, would be a very significant share of the U.S. market by 1983 and would destroy the domestic industry shortly thereafter. However, the record concerning complainant's shipments, sales volume, piece market share, and standard variable profit indicates a general upward trend. 60/

Complainant claims that specific instances of price reductions which are supported by the record. However, complainant's prices are considerably higher than both the respondents' prices and the prices of complainant's licensees. 61/ Respondents' prices are competitive with those of complainant's licensees, and, therefore, the majority of the domestic industry. 62/

Complainant also notes that it has had to reduce its workforce, but employee furloughs during the 1977-1981 period were due to reduced business in

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56/ FF 219.
57/ FF 221.
58/ FF 223.
59/ RD at 141.
60/ RD at 143-144.
61/ RD at 140.
62/ RX 2 at 14.

complainant's total product line, and thus one not necessarily attributable to respondents' activities. 63/

Finally, complainant argues that its inventory has increased significantly since respondents began importing their JD screws. While complainant's inventory has increased, this is due in part to complainant's increase in productive capacity and sales, and not solely because of respondents' activities. 64/

As previously indicated, complainant contends that it is entitled to the 14 percent market share currently enjoyed by Yamashima. The requisite connection between the accused imports and substantial injury to the domestic industry is usually established when:

> [a]n infringer holds a significant share of the domestic market for articles covered by the patent or. . . that the infringer has made a significant amount of domestic sales of the covered articles, as such sales rightfully belong only to the patentee (and/or any licensees). This obviously does not contemplate that a single sale lost by a patent holder will automatically result in substantial injury. The complainant is not released from the burden of establishing substantial injury, or of showing the requisite causal connection between the imports and injury. 65/

The finding of causation is reached in many section 337 cases in this manner, but in this investigation the question of causation has been complicated by the existence in the marketplace of non-party importers of allegedly noninfringing substitutes for the subject screws. Since some of these

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63/ RD at 143.
64/ RD at 140.
65/ Spring Assemblies and Components Thereof, and Methods for their Manufacture, Inv. No. 337-TA-88 at 44.

importers were in the U.S. market at the time respondents began to import their screws, it is not immediately clear that respondents' sales and market share were gained at the expense of the domestic industry.

In this regard, complainant has not sustained its burden of proof that respondents' imports caused any injury to the domestic industry. As noted previously, there is no information on the record that the domestic industry lost market share.

Respondents' expert witness, an economic and management consultant, indicated in his direct testimony that the dry wall screws market has been experiencing an increased price elasticity of demand. It has become more difficult for the manufacturers of better quality screws, such as those produced by complainants, to maintain higher prices and still retain their market share. Distributors of drill point screws for drywall construction have become more willing to purchase roughly equivalent screws at a lower price, especially to fulfill their needs for a second source of supply. 66/ The record indicates that the allegedly noninfringing imports are competitive with the screws of respondents and the domestic producers as a second source of supply. 67/ Indeed, Gyplok is also competing as a second source of supply and, thus, may be taking market share away from other importers. 68/

66/ RX-2C at 36-37, 67-69.

67/ Complainant included imports not subject to this investigation as part of the market competitive with the S-12 screw in an exhibit to the complaint. Inclusion of these imported screws as part of the market was supported by the unrebutted testimony of respondents' expert witness, an economic and management consultant.

68/ RX-2C at 58-60.

An important failure in complainant's attempt to link any injury to the domestic industry with respondents' imports is lack of information on direct market share shifts. The alleged lost sales were not substantiated. 69/ The only account lost by complainant was lost for reasons other than competition with respondents. 70/ The other distributors to whom complainant allegedly lost sales were purchasing respondents' screws as a second source of supply. Complainant retained its accounts with those distributors. 71/

Therefore, while the complainant has shown some evidence of injury, the complainant has failed to carry its burden of proving that the respondents' activities are causally related to any "substantial injury" to the domestic industry.

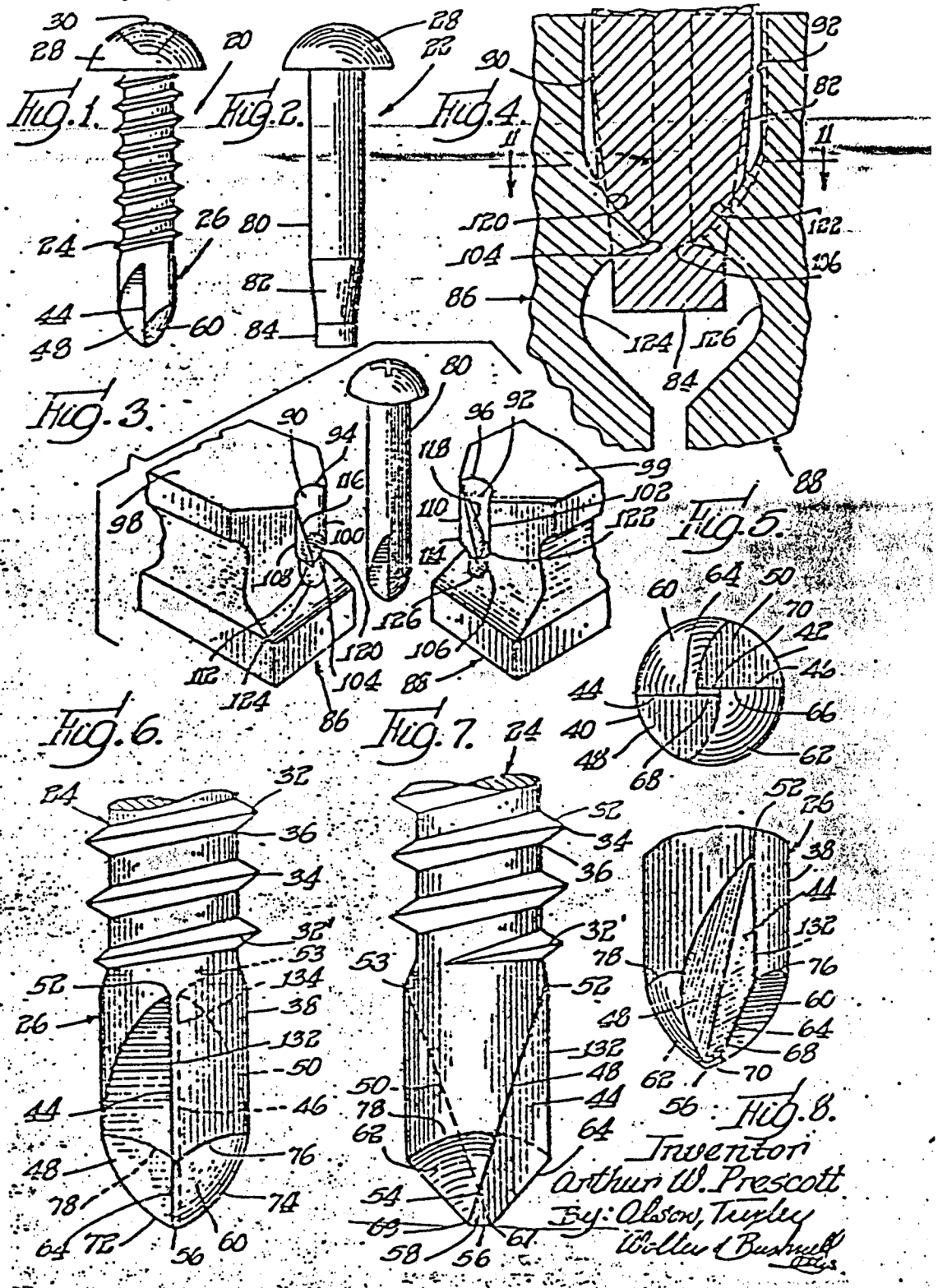
69/ FF 215-223.
70/ FF 221.
71/ FF 215-223.

ATTACHMENT A

Aug. 26, 1969 A. W. PRESCOTT 3,463,045

DRILLING SCREW

Filed May 10, 1966 2 Sheets-Sheet 1



Aug. 26, 1969 A. W. PRESCOTT 3,463,045

DRILLING SCREW

Filed May 10, 1966 2 Sheets-Sheet 2

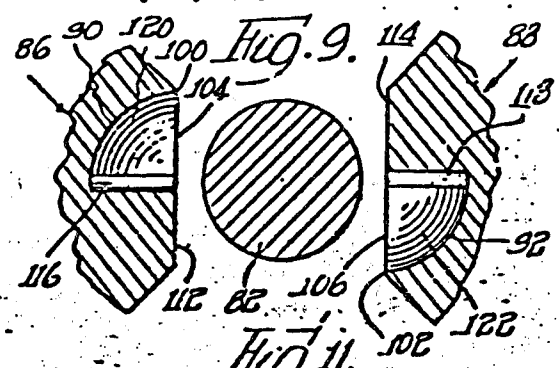


Fig. 9.

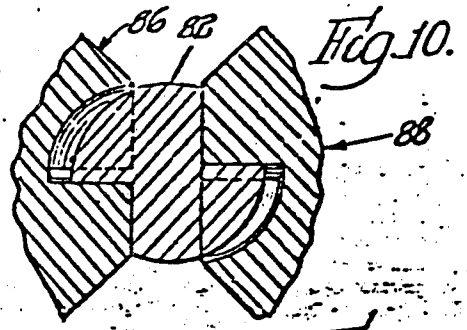


Fig. 10.

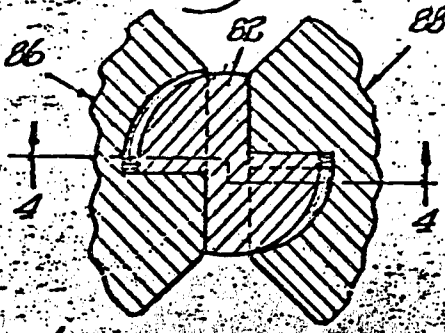


Fig. 11.

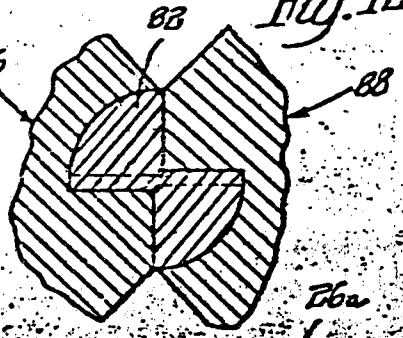


Fig. 12.

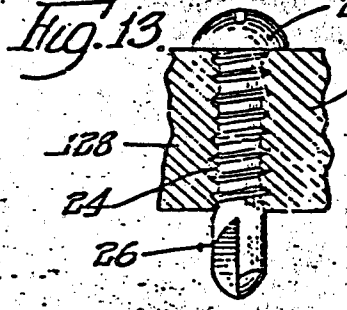


Fig. 13.

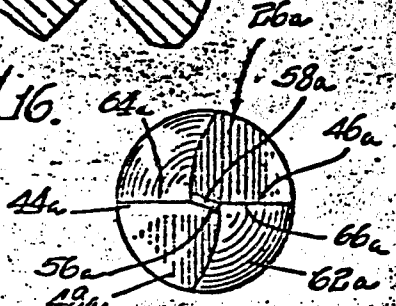


Fig. 16.

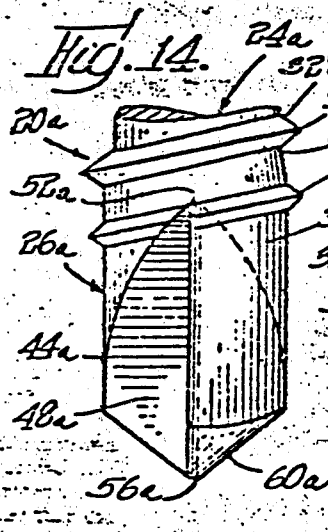


Fig. 14.

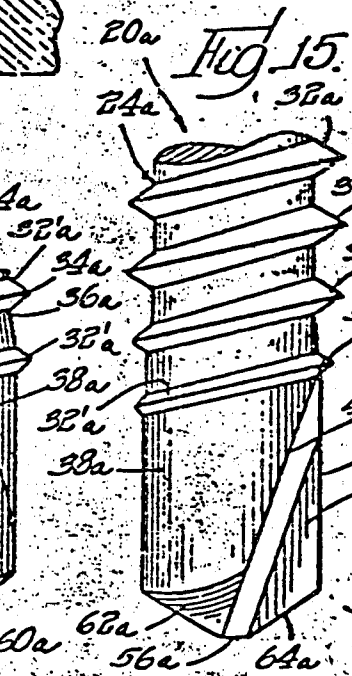


Fig. 15.

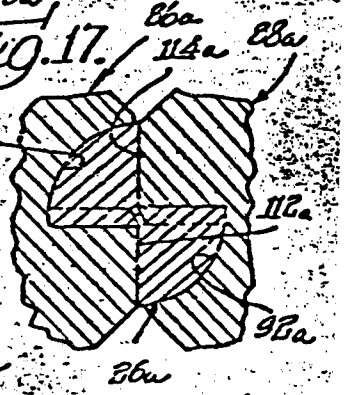


Fig. 17.

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3,463,045

DRILLING SCREW

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Int. Cl. F16b 25/00; B21h 3/08
U.S. Cl. 85—11 6 Claims

ABSTRACT OF THE DISCLOSURE

There is disclosed a drilling screw having a forged drilling tip. The forging is accomplished so as to provide flutes in a first pair of diagonally opposite quadrants of the tip while the remaining pair of diagonally opposite quadrants present rounded or convex end surfaces extending substantially continuously between the flutes. First surfaces of the flutes intersect peripheral surfaces of the tip to provide cutting edges and the rounded surfaces are relieved behind these cutting edges. The flutes extend across a plane containing the central axis of the screw so as to define therebetween a narrow web providing the screw with a relatively sharp tip including continuations of the aforementioned cutting edges.

The present invention relates to a novel screw structure and more specifically to a novel drilling screw.

There are many applications where the use of self-drilling and tapping screws is highly desirable in order to facilitate easy and economical assembly of parts. A variety of self-drilling screw structures have heretofore been proposed. Many of these have been considered to be significant advances in the art and have been successfully used, especially for particular purposes. It has been noted however that certain of these heretofore proposed devices have required use of relatively costly production or manufacturing procedures. In addition certain of such heretofore suggested screws have been constructed so as to obtain only a relatively inefficient drilling action.

It is an important object of the present invention to provide a novel drilling screw structure and method of producing the same whereby the screw is relatively highly efficient in operation and can be mass produced cheaply.

More specifically it is an important object of the present invention to provide a novel drilling screw structure and method of producing the same by pinch pointing or forging and so that relieved, well-supported and highly efficient cutting or drilling edges are obtained at the entering end of the screw.

A further important object of the present invention is to provide a novel drilling screw and method of making the same, which screw has a relatively strong and rugged entering end or drilling tip portions.

Still another object of the present invention is to provide a novel drilling screw having an entering end or tip portion formed for effectively cutting a hole in a workpiece in a manner which will facilitate subsequent starting of threads of the screw into the workpiece.

One embodiment of the present invention contemplates the inclusion of a forged drilling tip on a screw, said tip having flutes in a first pair of diagonally opposite quadrants while the remaining quadrants are substantially uninterrupted and present rounded or convex end surfaces. First surfaces of the flutes intersect the periphery of the tip and provide cutting edges at the intersections and the rounded end surfaces support but are relieved behind the cutting edges. The flutes are forged so as to traverse a plane containing the longitudinal axis of the screw to thereby define therebetween a narrow web providing the screw with a relatively sharp tip and including continuations of the cutting edges.

Other objects and advantages of the present invention will become apparent from the following description and the accompanying drawings wherein:

FIG. 1 is an elevational view showing a screw incorporating features of the present invention;

FIG. 2 is an elevational view showing a headed and unthreaded blank utilized in producing a screw in accordance with the features of the present invention;

FIG. 3 is an exploded perspective view showing the manner in which an entering end of the blank is pinch-pointed or forged in accordance with the features of the present invention;

FIG. 4 is an enlarged fragmentary sectional view taken generally along lines 4—4 in FIG. 11 and showing an intermediate step in the process of forging the entering end or drilling tip of the screw in accordance with features of the present invention;

FIG. 5 is an enlarged end view of the screw tip portion shown in FIG. 1;

FIG. 6 is a fragmentary side elevational view of a portion of the screw shown in FIG. 1;

FIG. 7 is an elevational view similar to FIG. 6 but showing the screw turned 90° from the position shown in FIG. 6;

FIG. 8 is a fragmentary elevational view showing an entering end portion of the screw turned 45° from the positions shown in both FIGS. 6 and 7;

FIGS. 9, 10, 11 and 12 are sectional views taken on the same plane as indicated by the sectional line 11—11 in FIG. 4 and respectively showing successive positions of pinch-pointing or forging dies during processing of a screw blank;

FIG. 13 is a sectional view on a reduced scale showing the manner of forming the threads on the screw blank;

FIG. 14 is a fragmentary elevational view similar to FIG. 6 but showing a modified form of the present invention;

FIG. 15 is an elevational view of the modified screw structure turned 90° from the position shown in FIG. 14;

FIG. 16 is an entering end view of the modified screw structure shown in FIGS. 14 and 15; and

FIG. 17 is a fragmentary sectional view similar to FIG. 12 but showing the manner in which the modified screw structure is formed.

Referring now more specifically to the drawings wherein like parts are designated by the same numerals throughout the various figures, a screw 20 incorporating features of the present invention is shown in FIGS. 1 and 5 through 8. The screw 20 is, in accordance with features of the present invention, formed from a blank 22 shown in FIG. 2 in a manner which will be described fully below.

The finished screw 20 comprises an elongated shank portion 24 which merges with an entering end or drilling tip portion 26. A trailing end of the shank portion is preferably provided with an enlarged head 28 having suitable driving tool accommodating slot means 30 formed therein.

Helical thread convolutions 32 are rolled on the shank portion 24. Preferably the convolutions extend from adjacent the head to the entering end portion or drilling tip 26, and, if desired, the convolutions may be extended onto the entering end portion or tip 26. The thread convolutions 32 are preferably formed so as to have a substantially uniform crest 34 of predetermined diameter throughout a major portion of the shank. However, one or more of the convolutions designated 32' adjacent to or merg-

ing with the entering end of the portion 26 has a progressively decreasing crest diameter or height in a direction extending toward the tip so as to facilitate starting of the thread convolutions into a workpiece. As shown best in FIGS. 6 and 7, the thread convolutions 32 are spaced apart axially of the screw shank and the roots 36 of the threads have a predetermined substantially uniform diameter which is less than the maximum diameter of the entering end portion or drilling tip 26 as will be described more in detail below.

The entering end portion or drilling tip 26 is pinch-pointed or forged so as to have a generally cylindrical body 38. Oppositely disposed flutes 40 and 42 are formed in the tip body. These flutes are respectively defined by first substantially flat parallel surfaces 44 and 46 facing in opposite directions and located substantially at but slightly offset oppositely from a parallel plane bisecting the screw shank. The flutes are further defined by second surfaces 48 and 50 respectively perpendicular to the surfaces 44 and 46 and disposed in planes which are oppositely inclined with respect to the longitudinal axis of the screw.

As shown best in FIGS. 5 and 7, the inclined flute surfaces 48 and 50 have a minimum or zero depth at starting points 52 and 53 respectively adjacent the trailing end of the tip portion and extend so that the planes thereof intersect each other at a point 54 (see FIG. 7) coincident with the longitudinal axis of the screw and spaced axially inwardly from a free terminal edge or tip 56 of the screw. Thus the entering end portion is formed with a narrow web element 58 between the imaginary point 54 and the tip 56. Opposite sides of the web portion 58 are in fact continuations of the flute surfaces 44 and 46. This narrow web or tip portion which has a triangular configuration as shown in FIG. 7 provides the screw with a strong well-supported yet relatively thin or sharp point for facilitating initial entry into a workpiece during a drilling operation.

The end portion 26 of the screw is formed with end surfaces 60 and 62 between the flutes. The surfaces 60 and 62 are respectively intersected by the flute surfaces 44 and 46 along substantially straight edges 64 and 66 which flair outwardly and rearwardly from junctions 67 and 69 with opposite ends or corners of the web portion 58. As indicated in FIG. 7 these junctions which also coincide with the planes of the oppositely inclined flute surfaces are located at opposite sides of the central axis of the screw but at the same time are close together so that the length of the tip edge 56 is short for providing the screw with a sharp work-penetrating tip. The diverging edges 64 and 66 are continuations of edges 68 and 70 at opposite sides of the web element and serve therewith as cutting or drilling edges for the tip portion of the screw.

In order to increase the effectiveness of the cutting action of the edges 64 and 66, the end surfaces 60 and 62 are relieved immediately behind the edges whereby to avoid interference with the work. At the same time the end surfaces 60 and 62 are rounded and approach the configuration of a segment of a sphere so as to impart improved strength and resistance to wearing or breakage. While, as indicated, the end surfaces 60 and 62 approach the configuration of a segment of a sphere, they are slightly flattened so as to provide the aforementioned relief behind the cutting edges. In other words, the radius of curvature of the end surfaces 60 and 62 varies and is greater than the radius of the generally cylindrical tip portion body 38. This configuration is shown best in FIGS. 6 and 8 wherein are shown curved edges 72 and 74 at junctions between the flute surfaces 48 and 50 and the end surfaces 60 and 62 respectively. As shown, the curved edges 72 and 74 extend axially of the screw shank a distance substantially greater than the axial extent of the cutting edges 64 and 66. This relationship is further brought out by the configuration of junction lines 76 and 78 between the end surfaces 60 and 62 and cylindrical side surfaces of the body 38.

As previously indicated, the screw 20 is in accordance with a feature of the present invention, formed from the blank 22. The blank is initially provided with the previously described head portion 28 from which extends a smooth unthreaded shank 80. The shank portion 80 corresponds to the previously described threaded shank portion 24, but initially the shank portion 80 has a substantially uniform diameter which is less than the maximum diameter of the crests 34 of the thread convolutions 32 and greater than the diameter of the roots 36.

The shank portion 80 of the screw blank merges with a tapering or conical portion 82 which in turn merges with a reduced diameter free end portion 84. The axial length of the tapering portion 82 is similar in length to the entering end or tip portion 26 of the finished screw. Furthermore, the degree to which the portion 82 is tapered is related to the size and position of the flutes in the finished screw so that when the tip portion is forged in the manner described below, the resulting cylindrical body portion 38 will have a diameter which is substantially uniform and substatnially the same as the initial diameter of the unthreaded shank portion 80.

In order to form the drilling tip portion in accordance with the present invention, pinch-pointing or forging dies 86 and 88 shown in FIGS. 3, 4 and 9–12 are used. These dies are adapted to be mounted in and actuated by apparatus of known construction which need not be described in detail. As is known, such machines are capable of operating at high speeds so that screw blanks may be processed and formed with drilling tips in accordance with the present invention at rates, which for example, may be on the order of several hundred per minute.

The dies 86 and 88 are identically constructed and are mounted in directly opposed relationship for reciprocable movement between a fully opened position as shown in FIG. 9 and a fully closed position as shown in FIG. 12 during a screw blank processing operation.

The dies 86 and 88 are respectively formed with identical cavities 90 and 92 having upper ends in the form of segments of a cylinder as indicated by semi-circular lines 94 and 96 at junctions between the cavity surfaces and upper surfaces 98 and 99 of the die block. The radius of the cavities 90 and 92 at the upper ends thereof is substantially the same as the radius of the unthreaded shank portion 80 of the screw blank. The cavities 90 and 92 are respectively defined by straight vertical cutting edges 100 and 102 along one side thereof which edges serve to confine the blank during a forging operation and to trim any flashing therefrom as will be described more in detail below. The edges 100 and 102 respectively merge with downwardly and inwardly inclined edges 104 and 106 which serve to trim off the extra tip portion 84 of the screw blank along the previously described straight cutting edges 64 and 66.

As shown in the drawings and particularly in FIG. 3, the cavities 90 and 92 of the die blocks are partially filled with lands 108 and 110 respectively defined by flat forwardly facing anvil surfaces 112 and 114 and by inclined side surfaces 116 and 118 perpendicular thereto. The construction is such that the surfaces 112 and 114 are adapted to form the flute surfaces 44 and 46 while the arrangement of the die surfaces 116 and 118 determines the arrangement of the flute surfaces 48 and 50.

Lower end portions of the die cavities are respectively formed with rounded surfaces 120 and 122. These rounded surfaces which extend from the intersections with the cutting edges 104 and 106 provide mold forms against which the material of the screw blank is pressed and forged for obtaining the previously described curved and relieved end surfaces 60 and 62 of the screw drilling tip portion. In other words, the surface portions 120 and 122

of the dies correspon[illegible]onfiguration to the previously described shape of th[illegible]w end surfaces 60 and 62.

When the dies are brought together during a blank forming operation, the cutting edges 100 and 104 register with the flat surface 114 while the cutting edges 102 and 106 register with the flat surface 112 for trimming the screw tip to the previously described configuration. As shown in FIGS. 3 and 4, the die blocks are relieved as at 124 and 126 beneath the lower ends of the cutting edges 104 and 106 so as to provide clearance for the excess tip portion 84 of the blank.

When forming a drilling tip on a blank in accordance with the present invention, the blank is first placed between the open dies as shown in FIG. 9. Then the dies are moved together successively through the positions shown in FIGS. 10 and 11 to the final position shown in FIG. 12. During such movement, the land portions 108 and 110 of the dies progressively displace the material of the blank tapered portion 82 in order to form the previously described flutes. The initially tapering configuration of the blank portion 82 shown in FIG. 2 and in broken lines in FIG. 4 is correlated with the configuration of the die so that this displacement of the material begins adjacent the large diameter end of the shank portion 82 and progressively increases toward the small diameter end. As the dies move toward the closed position of FIG. 12, it is seen that the blank material from generally diagonally opposite quadrants is forced by the land of each die into the pocket of the opposite die. As this action progresses, the material is forced from the initially tapered or conical configuration as indicated by broken lines in FIG. 4 toward the generally cylindrical configuration of the sides of the pockets. Furthermore, the material is forced or extruded axially and radially against the rounded surfaces 120 and 122 at the lower ends of the pockets as shown in an intermediate stage in FIG. 4 for obtaining the end surfaces 60 and 62. This forming action is completed as the die is moved to the fully closed position shown in FIG. 12 and at the same time the lower excess end portion 84 is trimmed from the remainder of the blank. The volume of the material originally in the blank portion 82 is preferably at least slightly in excess of that needed for the finished tip and such excess material is trimmed away by the dies during the forming operation.

After the drilling tip has been formed as described hereinabove, the blank is passed between thread rolling dies 128 and 130 as shown in FIG. 13. The construction of such thread rolling dies and the operation thereof is well known and need not be described in detail. It suffices to state that the action is such that the thread convolutions 32 are formed as previously described so that the crest diameter thereof is greater than the diameter of the unthreaded shank portion 80 while the root diameter is less than the diameter of the unthreaded shank portion 80 and also less than the diameter of the tip body 38. Thus, the cutting edges 64 and 66 are adapted to drill a hole in a workpiece having a diameter greater than the root diameter of the threads and continuations of these cutting edges indicated by the numerals 132 and 134 and extending along the cylindrical sides of the tip body 38 are adapted to ream out the aperture in the workpiece to a diameter greater than the root diameter of the threads. Also as previously indicated, the threads may be rolled so that they terminate substantially at the upper end of the drilling tip portion, or the threads may be formed so as to extend at least partially along the tip portion. Furthermore, thread convolutions may even be extended so as to be intersected by the flutes. Preferably any such threads extending along the drilling tip portion are formed so as to progressively decrease in height and diameter toward the extreme tip of the screw. After the forming operations have been completed the screws which are formed from steel or other suitable metal materials may be heat-treated and hardened for enabling them to be applied to workpieces formed from metal or other hard substances.

In FIGS[illegible]brough 17 there is shown a slightly modified form[illegible]e present invention wherein the screw structure is similar to that described above as indicated by the application of identical reference numerals with the suffix *a* added to corresponding elements. The screw in this embodiment may be formed by the same method as that described above and differs only in that the dies are modified for locating the drilling or cutting edges 64*a* and 66*a* in a common plane which also contains a longitudinal axis of the screw. In addition, the die is slightly modified so that the central web or tip portion 58*a* and opposite sides thereof which are continuations of the surfaces 44*a* and 46*a* are inclined slightly diagonally with respect to the aforementioned plane. In other words, the extreme tip edge 56*a* is disposed slightly diagonally at an angle with respect to the common plane of the cutting edges 64*a* and 66*a*. For example the angle of inclination may be on the order of about 15°.

The opposite cutting edges 64 and 66 in the previously described embodiment are, as indicated, only slightly offset with respect to each other and from a plane bisecting the screw so that there is little tendency for the screw to wobble as it is being driven into a workpiece. However, the arrangement shown in FIGS. 14–16 wherein these corresponding cutting edges are in the same plane further promotes a straight and efficient drilling action. Screw 20*a* as disclosed also shows how the thread convolutions 32'*a* may be extended along the tip portion 26*a*, but it is to be understood that these threads could be terminated above the tip portion, if desired. In general, the arrangement should be such that the length of the unthreaded portion of the tip equals or exceeds the thickness of the workpiece to which the screw is to be applied. This enables the drilling operation to be completed before the threads engage the workpiece.

While preferred embodiments of the present invention have been shown and described herein, it is obvious that many details may be changed.

The invention is claimed as follows:

1. A drilling screw comprising an elongated shank, driving tool accommodating means integral with a trailing end of said shank, said shank including a forged drilling end portion at a leading end thereof, and helical thread convolutions extending along said shank and having a predetermined maximum crest diameter and a smaller root diameter, said drilling end portion comprising a body having a diameter less than said predetermined crest diameter and greater than said root diameter, a pair of oppositely disposed forged flute means in quadrants of said body located daigonally from each other substantially at opposite sides of a first plane containing the longitudinal axis of said shank, said body including outwardly and axially rearwardly flaring entering end surfaces substantially traversing quadrants between said flute means, said flute means being partially defined by first flute surfaces intersecting said end surfaces at cutting edges adjacent said plane, said flute surfaces traversing a second plane in the vicinity of a free terminal end of said body, said second plane also containing said axis and being disposed perpendicular to said first plane, said body including a narrow web between said flute surfaces at said free terminal end and presenting a narrow tip edge for initial engagement with a workpiece during a drilling operation, said cutting edges including portions disposed substantially in a common plane and traversing said web portion and defining opposite side corners of said tip edge, said cutting edges including additional portions flaring outwardly, and said end surfaces being forged and relieved behind said cutting edges with said end surfaces having a convex configuration and varying radii of curvature greater than the radius of said body.

2. A drilling screw, as defined in claim 1, wherein said cutting edges are substantially parallel to and slightly oppositely offset from said first plane.

3. A drilling screw, as defined in claim 1, wherein major

parts of said cutting edge disposed substantially in said first plane, and said portions of said cutting edges and said web are inclined about the axis of the shank with respect to said first plane.

4. A drilling screw, as defined in claim 1, wherein said narrow web has an inverted generally triangular configuration.

5. A drilling screw, as defined in claim 1, wherein said body comprises generally cylindrical side surfaces, said first flute surfaces intersecting said side surfaces at longitudinally extending cutting and reaming edges located on a diameter greater than said root diameter.

6. A drilling screw, as defined in claim 5, wherein said flute means are partially defined by second flute surfaces respectively perpendicular to said first flute surfaces and extending from trailing ends of said cutting and reaming edges diagonally across said second plane and to opposite corners of said tip edge.

References Cited

UNITED STATES PATENTS

3,079,831	3/1963	Gutshall	85—47
3,125,923	3/1964	Hanneman	85—47
3,241,426	3/1966	Gutshall	85—47
3,318,182	5/1967	Carlson	85—41

FOREIGN PATENTS

639,198	5/1962	Italy.
976,849	12/1964	Great Britain.
690,269	4/1953	Great Britain.

MARION PARSONS, Jr., Primary Examiner

U.S. Cl. X.R.

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