June 19, 1956 J. A. SMITH ET AL 2,751,031

CONDITIONING PAPER-MAKING STOCK

Filed May 21, 1953 3 Sheets-Sheet 1

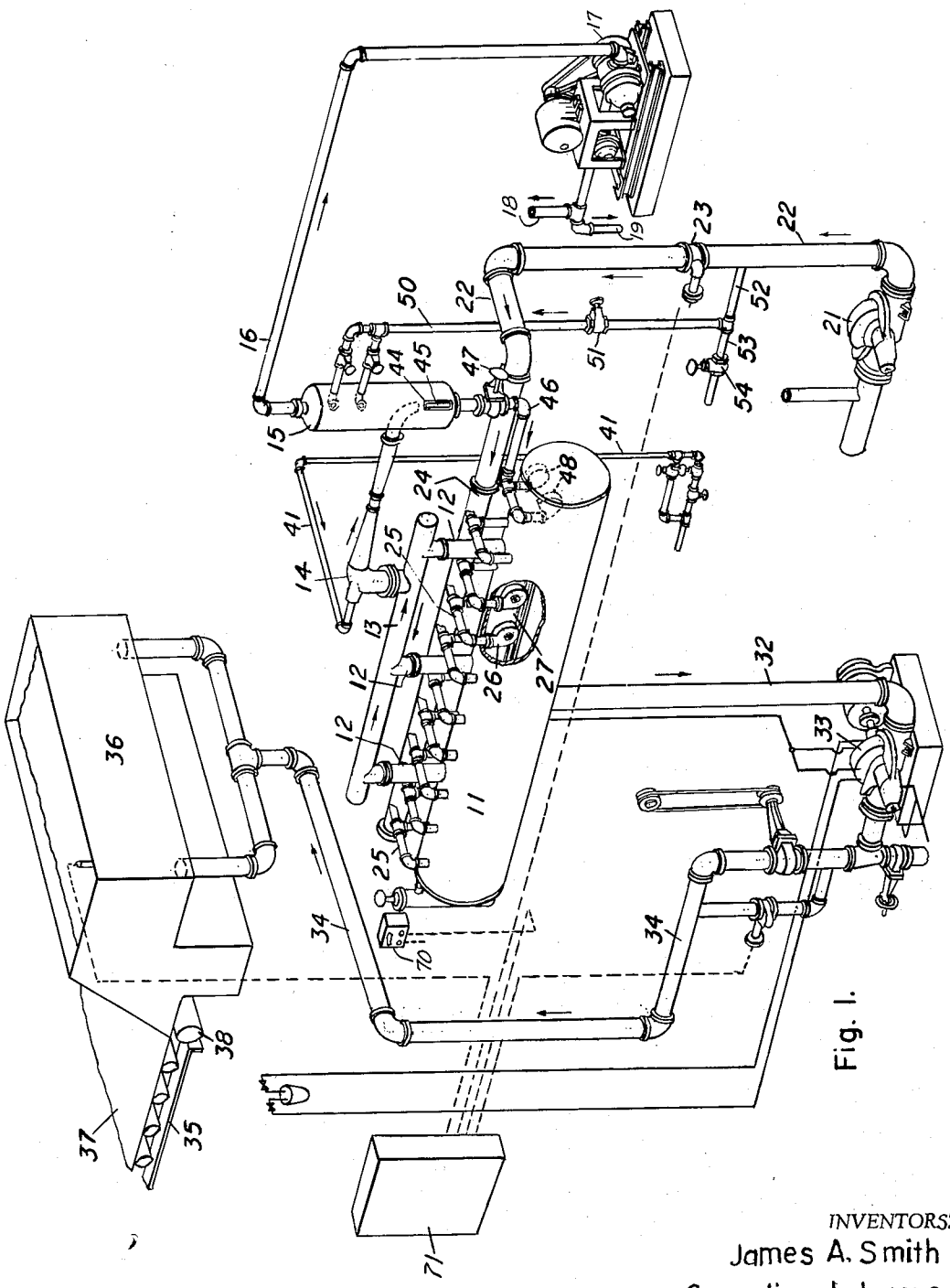


Fig. 1.

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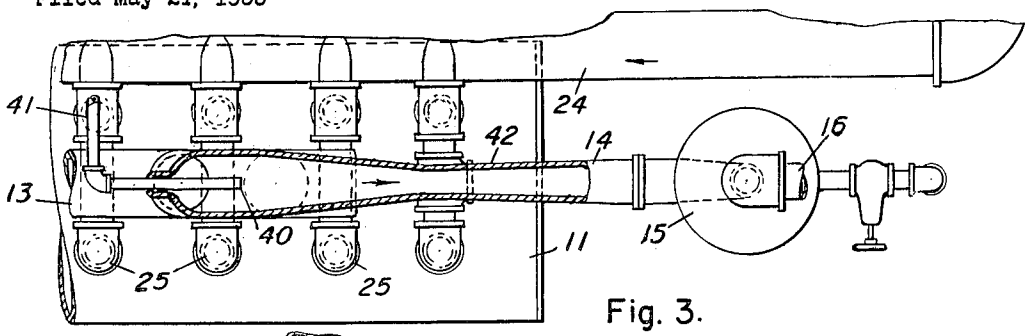


Fig. 3.

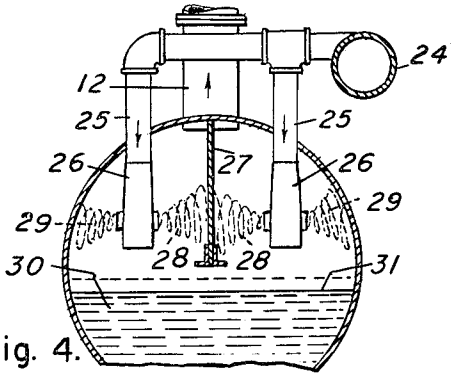


Fig. 4.

Fig. 2.

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Filed May 21, 1953 3 Sheets-Sheet 3

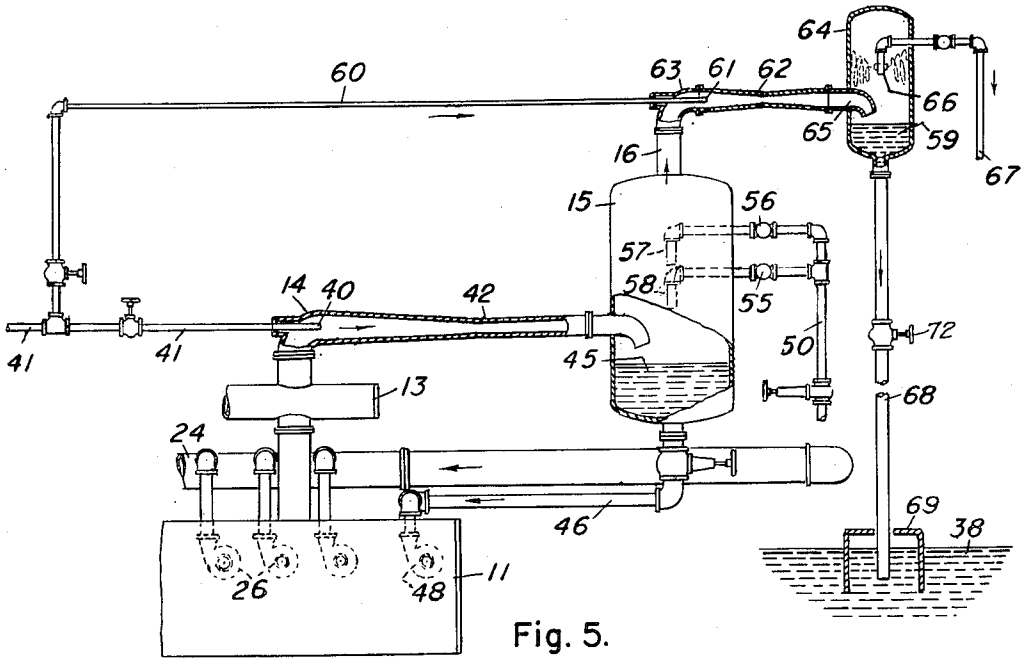


Fig. 5.

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United States Patent Office 2,751,031 Patented June 19, 1956

2,751,031

CONDITIONING PAPER-MAKING STOCK

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Application May 21, 1953, Serial No. 356,382

2 Claims. (Cl. 183—2.5)

This invention relates to devices for de-aerating dilute suspensions such as paper-making stock and other paper-making constituents. More particularly it relates to improvements in the kind of de-aerator illustrated in the patent to Clark and Vicario, No. 2,614,656, granted October 21, 1952. In that patent, the dilute paper stock to be de-aerated before it goes to a paper-making machine is atomizingly sprayed into a stock-deaerating receiver tank maintained under the effect of high vacuum, and in the receiver, the sprayed atomized dilute stock, during its de-aeration by the vacuum, falls to be collected in a pool of de-aerated stock whose liquid-level is maintained constant. De-aerated stock is then conducted to the paper-making machine under air-excluding conditions. The effect of vacuum is applied to the receiver by means of piping leading to a vacuum-producer, such as a pump. The pump, in applying suction through the piping to the receiver, sucks a certain amount of moist vapor, if not actual water, and this has to be returned to atmospheric pressure through a condenser tank with which is connected a barometric drop-leg. Such a leg, as is known, is of the order of 34 feet long so this takes up a lot of head-room in the paper-mill. So it is among the objects of this invention to eliminate from the arrangement of said patent the need for a barometric drop-leg, with its high head-room requirement; and to eliminate the requirement of cooling water in the condenser.

These objects were attained by the use of dilute paper-making stock, or white water, as the cooling medium or coolant, which was collected in the bottom of the condenser as a pool thereof, and then conducted back to the receiver tank, to be injected therein in the form of an atomized spray. This recycling arrangement gave rise to a new problem, namely, of generating enough pressure on the condensate with its suspended paper-making fibers to force it through an atomizing spray nozzle in the receiver. Normally, it would be expected that a pump would be necessary, so it became another object of this invention to devise ways and means other than a pump to accomplish this pressure build-up. This recycling arrangement then gave rise to another object of this invention, namely, to eliminate the vacuum pumping station altogether. Both of these objects are realized by a single means that accomplishes these dual results. The single means comprise a steam jet ejector placed ahead of the condenser in the vapor-sucking pipeline leading from the receiver, as a substitute for at least one stage of a vacuum pump station. The object to eliminate vacuum pumps altogether was realized by the use of a sequence of steam jet ejectors with a condenser following each ejector. With such a sequence of ejectors, the condensate from the last one, having been brought up substantially to atmospheric pressure, does not need to be returned to the receiver but can be emitted to the atmosphere without a barometric drop-leg.

Then, in those installations where one or more steam ejectors are used, operating on high pressure steam, it is an important object of this invention to recover a significant quantity of British thermal units (B. t. u.) of heat from that steam, which otherwise would be lost in going down the barometric drop-leg with the high pressure steam condensate. This is important especially in northern paper-mills where steam is relatively expensive. It is also quite important in southern mills where, although steam is not as expensive, large quantities are consumed in heating the dilute paper-making stock to high temperatures. In the southern mills making kraft paper, temperatures run around 135° F. in the headbox, while in northern mills, the temperature runs around 100° F. in making newsprint. The higher temperatures in the southern mills tend to better drainage of the water from the fibre on the Fourdrinier wire, which is what these mills require in order to operate at very high speeds to produce very high tonnages. This object of heat-recovery from the high pressure steam used by the vacuum-producing ejector station is realized by recycling to the stock-treating receiver in atomized spray form, the condensate from the condenser which comprises fibre-bearing stock, condensed vapor, and condensed steam. The super-pressure created in the condenser by the steam from the ejector provides the necessary force to spray the condensate from a maintained pool thereof back into the receiver for re-treatment therein for de-aeration.

The foregoing objects are realizable by using ways and means comprising apparatus that can be made to function by maintaining the de-aerating effect of vacuum in an enclosed de-aerating chamber by a vacuum-producer, atomizingly spraying the suspension into the chamber, maintaining constant the liquid-level of a pool of such sprayed suspension that has thus become de-aerated, conducting such de-aerated suspension to discharge, sucking vapor from the chamber to the vacuum-producer meanwhile condensing condensables of such vapor and collecting a pool thereof shielded from the atmosphere, and conducting condensate from that pool back to the chamber by spraying it into the chamber. Other steps comprise effecting the condensing in the presence of atomizingly sprayed dilute suspension such as goes to the chamber. Also, the vapor from the chamber can be impelled to the place of its condensing by a steam-ejector. Further, the vacuum-producer, instead of involving a vacuum-pump, can be a sequence of steam-ejectors each followed by a condenser with a vapor from a preceding condensing step being acted on by a subsequent ejector, and the condensate from the final condensing step emitted to the atmosphere.

The invention has been illustrated in the accompanying drawings which show two embodiments of the invention, for illustrative but not limiting purposes. In the drawings, Figure 1 is an isometric view, with parts broken away of the entire system in its usual environment. Fig. 2 is a vertical sectional view through a portion of the stock receiver tank, the vacuum-header, the stock-feeder header, the condenser, its coolant supply, and the steam ejector. Fig. 3 is a plan view, wth parts in section of the parts shown in Fig. 2. Fig. 4 is a vertical sectional view taken through the stock receiver, with details of the atomizing spray nozzles. And Fig. 5 is a somewhat diagrammatic view of a modification.

In the drawings, the enclosed chamber wherein the stock or dilute suspension to be de-aerated is a stock-deaerating receiver or tank **11** on which the de-aerating effect of vacuum is maintained through pipes **12** leading to a vacuum-header **13** connected by a pipe **14** to a condenser **15** whose top has a pipe **16** leading to a vacuum-producer or vacuum pump **17**, from which vapor is exhausted through pipe **18** and water through pipe **19**. Stock to be de-aerated is pumped by centrifugal or fan pump **21** through feed pipe **22** in which is an automatic control valve **23**. Pipe **22** leads to a stock-feed header **24** with

which is connected a plurality of feed pipes 25, each leading and discharging into a double atomizing spray nozzle 26 within the tank 11. In the tank between each lateral pair of nozzles is an impingement plate 27 against which the inwardly directed sprays 28 impinge. The outwardly-directed sprays 29 impinge against the inner wall of the tank. The sprays atomize the stock that is in dilute suspension into a mist or fog that assumes a somewhat spiralized path toward its impingement. This mist or fog of stock which has thus been de-aerated by the vacuum within the tank, falls toward the bottom of the tank where it is collected in a pond or pool 30 thereof, whose liquid-level 31 is controlled to be constant, at about the mid-height of the tank. De-aerated stock from this pool 30 is drawn off from the bottom thereof through stock draw-off pipe 32 by pump 33 through stock delivery pipe 34 to the head-box 36 of the paper-making machine 35 of which 37 represents the wire, and 38 the wire-pit.

To the pipe 14 in the suction line from the vacuum-header 13, is a steam jet ejector 40 fed from a high-pressure steamline 41 coming from any suitable source, that injects steam into the venturi section 42 of the vacuum pipe 14 that terminates in a downwardly-directed open elbow 43 in the condenser 15. The condenser has a sight glass at 44 through which can be seen the liquid-level of the maintained pool 45 of condensate reaching to an elevation above the tank 11. Condensate flows from the pool thereof through pipe 46 from its bottom, valved at 47, to the tank 11, wherein it is connected with two dual atomizing spray nozzles 48. The coolant for the condenser 15 is provided through coolant pipe 50, valved at 51, leading through branch pipe 52 connected with the stock feed pipe 22 ahead of its automatic valve 23, or from other sources such as branch pipe 53 valved at 54. The upper end of the coolant pipe 50 is branched again at 55 and 56, both of which are valved, and each terminates in the condenser 15, in an atomizing spray nozzle 57 and 58, respectively, similar in construction and function to spray nozzles 26 and 48, for forming into a mist or fog the stock suspension used as a coolant for the condenser.

Fig. 5 shows a modification that differs from the arrangement of the other figures, and particularly Fig. 2, by the absence of vacuum-pumps and by the use of an additional set or sets of steam ejector and condenser. So in this figure, the reference numerals up to 58 indicate the same elements as in the earlier figures. The added structure, or second stage condensing, is illustrated by using in the top pipe 16 from condenser 15, a second steam-ejector 61, fed with high-pressure steam through pipe 60 from steam supply pipe 41, or other suitable source. This second or secondary steam ejector is in a venturi section 62 of pipe 63 leading from condenser top pipe 16 to a second condenser 64 and terminating therein with an elbow 65. In that condenser is one or more atomizing spray nozzles 66 for spraying into the secondary condenser white-water, or stock from the receiver 11, conveyed to the nozzle through pipe 67. Condensate from a pool 59 thereof in this condenser can be carried to discharge through pipe 68 valved at 72 leading to a splash box 69 in the wire pit 38. This pipe 68 is not a barometric drop-leg. Valve 72 can be used to control the height of the liquid-level of the pool 59 in condenser 64.

Referring back to Fig. 1, 70 indicates an automatic controller of the liquid-level of the de-aerated stock pool in the stock receiver 11, by making the incoming feed equal to the withdrawn de-aerated stock, while 71 indicates an indicator panel for showing what is happening in the various stations, and, if desired, containing any necessary or desired controls.

In operation, dilute paper-making stock is pumped by pump 21 through stock feed pipe 22 in quantity regulated by valve 23, to stock header 24 and feed pipes 25 to be atomizingly sprayed through spray nozzles 26 to be impinged against either impingement plate 27, or the side walls of the stock receiver tank 11, to become atomized as to simulate a mist or fog. Meanwhile, the effect of vacuum is produced within the receiver 11 by a primary vacuum-producing high-pressure steam ejector 40 supplied with steam through pipe 41, with the vacuum operating through vacuum header 13 and branch pipes 12 on the receiver. Secondary vacuum-producing means is the pump 17 sucking through pipe 16 from condenser 15 into which the steam ejector discharges. The vacuum effective within the receiver 11 de-aerates the atomized stock sprayed thereinto, and the de-aerated stock falls to collect in a pool 30 whose liquid-level 31 is maintained constant. De-aerated stock from the pool is conducted under air-excluding conditions through stock drawoff pipe 32 by pump 33 and conducted to the head-box 36 of a paper-machine.

Primary condenser 15 has supplied thereto as the coolant, de-aerated stock from the receiver 11, or white-water from the paper-mill, an important feature being that the coolant is a suspension of paper-making fibres. The coolant is atomizingly sprayed into the condenser 15 through atomizing spray nozzles 57 and 58. It is led thereto through branch pipes 55 and 56 from coolant supply pipe 50 that comes either from the main stock feed pipe 22 via pipe 52, or from some other source through pipe 53. The atomized coolant suspension falls to the bottom of condenser 15 where a maintained pool 45 thereof forms including condensate from the vapors and any fibres entrained therein, fed thereto by the steam ejector 40 through pipe 14, and elbow 43. The depth of the pool heated by steam from the jet to a temperature substantially as hot as that of the pool 30 in the tank 11 is controlled by means of valve 47 by an operator observing the liquid-level of the pool 45 through sight-glass 44. Pressure greater than the sub-pressure in the tank 11, built up in the condenser 15 by compression resulting from the steam ejector 40, and by the elevation of the maintained pool of condensate above the tank 11, is sufficient to force liquid from the pool 45 through pipe 46 to be emitted from atomizing spray nozzles 48 in the stock receiver 11, and thus returned to that receiver to be re-deaerated therein. Non-condensates are sucked from the top of the condenser 15 through pipe 16 by vacuum pump 17, and discharged.

In Fig. 5 the vacuum pump 17 has substituted for it, a second or secondary steam-ejector and condenser station, wherein the operations of primary condenser 15 are repeated, only condensate from a pool 59 thereof is conducted through pipe 68 past a splash plate 69 to be returned to the wire pit 38 of the paper-machine. This secondary condenser can be smaller than the primary condenser. Also further ejector-condenser stations can be used, if desired.

Features of advantage of the invention include the elimination of the necessity for a barometric drop-leg by using as a coolant for the condenser a dilute stock of paper-making fibres such as can be de-aerated in the de-aerating stock receiver; recovery of the heat value of the steam used in the ejector and use of the recovered heat in place of another source of heat that otherwise would be required to maintain the temperature of the dilute paper-making stock at some other point in the paper-making process; elimination of complex piping from the receiver to the ejector; elimination of fresh cooling water; and providing means for building the assembly of receiver, steam ejector, and condenser in one complete closely-connected unit instead of having these units separate and situated remotely from each other. From the manufacturing standpoint, this is important inasmuch as handling and shipping of these components is thus simplified; and as from the installation standpoint, the cost is significantly reduced.

As this invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive, since the scope of the invention is defined by the appended claims rather than by the description preceding them, and all changes that fall

within the metes and bounds of the claims or that form their functional as well as conjointly co-operative equivalents, are therefore, intended to be embraced by those claims.

We claim:

1. The continuous process of de-aerating a liquid suspension of paper-making constituents while heated to mill stock temperature, which comprises pumping such heated suspension and atomizingly spraying it into an enclosed de-aerating chamber, maintaining the effect of high vacuum in the chamber by suction of a steam-jet ejector, maintaining constant the liquid-level of a pool in the chamber of such sprayed de-aerated suspension, conducting such suspension from the pool under air-excluding conditions to the place of its use, sucking air from the chamber by the jet, conveying steam and sucked air from the jet to the atmosphere of an enclosed condenser, condensing the condensables in said steam and air by supplying to the steam and air entering the condenser a dilute suspension of paper-making constituents; collecting a quantity of such condensate and maintaining a pool thereof reaching to an elevation above the chamber but below the point of entry of the steam and air into the condenser while shielded from the atmosphere to receive and retain heat and pressure supplied thereto by the steam from the jet, and forcibly atomizingly spraying into the chamber such heated condensate from the maintained pool thereof independently of the said pumped spraying to de-aerate it while using as a correlated force therefor the steam-jet-induced pressure thereon plus the elevation of the pool whereby the pressure on the elevated condensate is greater than the pressure in the chamber and the heat of the steam is retained by rising temperature of the condensate to be substantially as hot as that of the pool in the chamber.

2. A de-aerating system for a liquid suspension of paper-making constituents while heated to mill stock temperature, which comprises an enclosed de-aerating tank, atomizing spray nozzles in the tank, pump means for forcibly supplying such heated suspension to some of the nozzles but not to at least one other, means for maintaining constant the liquid-level of a pool of such de-aerated suspension collected in the bottom of the tank, means for passing de-aerated heated suspension from that pool, a steam-jet ejector vacuum-producer connected by piping to the tank for maintaining the effect of high vacuum in the tank, closed condenser means, means for maintaining in the condenser at an elevation above that of the tank a pool of condensate, means for supplying into the condenser a dilute suspension of paper-making constituents, means for delivering steam and air from the steam jet into the condenser above its pool to apply pressure on and heat to the pool to heat the latter to a temperature at least as high as that of the pool in the tank, and means connecting the pool of condensate with a remaining spray nozzle in the tank through which condensate from the maintained pool thereof is sprayed independently into the tank by the combined force of the elevation of the pool of condensate and the pressure thereon which force is greater than the pressure in the tank and the temperature of which spray is substantially as high as that of the pool in the tank.

References Cited in the file of this patent

UNITED STATES PATENTS

1,288,058	Leblanc	Dec. 17, 1918
1,611,256	Suczek	Dec. 21, 1926
1,778,302	Schubert	Oct. 14, 1930
2,223,237	Cooke	Nov. 26, 1940
2,614,656	Clark et al.	Oct. 21, 1952

FOREIGN PATENTS

638,198	Great Britain	May 31, 1950