United States Patent

Hamilton et al.

[15] **3,642,041**

[45] **Feb. 15, 1972**

[54] MOBILE TREE-PROCESSING MACHINE

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[73] Assignees: **Canadian Internal Paper Company; Quebec North Shore Paper Company**, Montreal; **Abitibi St. Anne Paper Ltd.**, Beaupre, Canada

[22] Filed: **May 7, 1968**

[21] Appl. No.: **727,316**

[30] **Foreign Application Priority Data**

May 12, 1967 Canada 990,351

[52] **U.S. Cl.** ..... **144/309 AC**, 144/3 D, 198/53, 214/83.26

[51] **Int. Cl.** **A01g 23/02**

[58] **Field of Search** 144/245, 2, 3, 34, 309; 143/43, 46; 214/83, 83.14, 83.26

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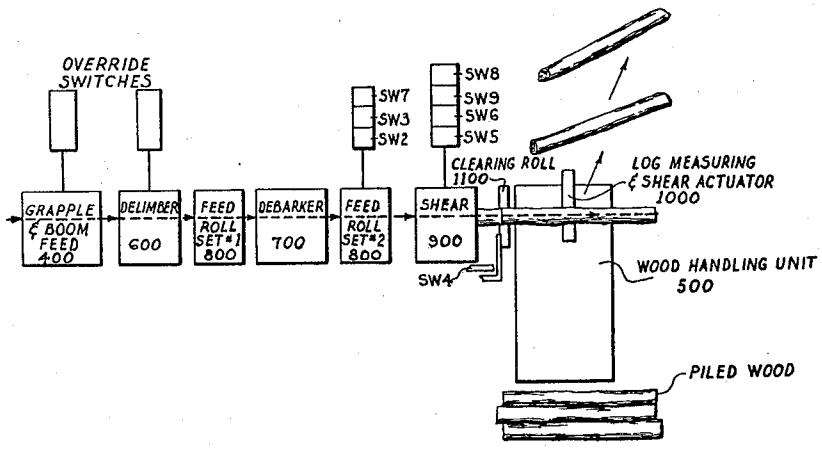
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Primary Examiner—Gerald A. Dost
Attorney—Jacobi, Lilling & Siegel

[57] **ABSTRACT**

A mobile tree-processing machine which includes a platform pivotally mounted on a mobile undercarriage for slewing about a vertical axis and having one or more tree-processing units mounted thereon operative to delimb, debark and/or sever whole trees fed thereto by a boom-and-grapple assembly and propelled through the processing units by feed means consisting of driven feed rollers. The leading end of the processed tree, emerging from he last of the processing units, actuates a cutter mechanism severing selected lengths which are directed by a deflector assembly onto an off-feed conveyor assembly which conveys the processed logs in sequence from the machine, depositing such processed logs at a position removed from the machine onto a suitable supporting surface. The off-feed conveyor, in one instance, is attached to the platform on which the processing units are mounted, and in another instance is independently mounted on the undercarriage for pivotal movement about a vertical axis independent of pivotal movement of the processing assembly.

43 Claims, 39 Drawing Figures



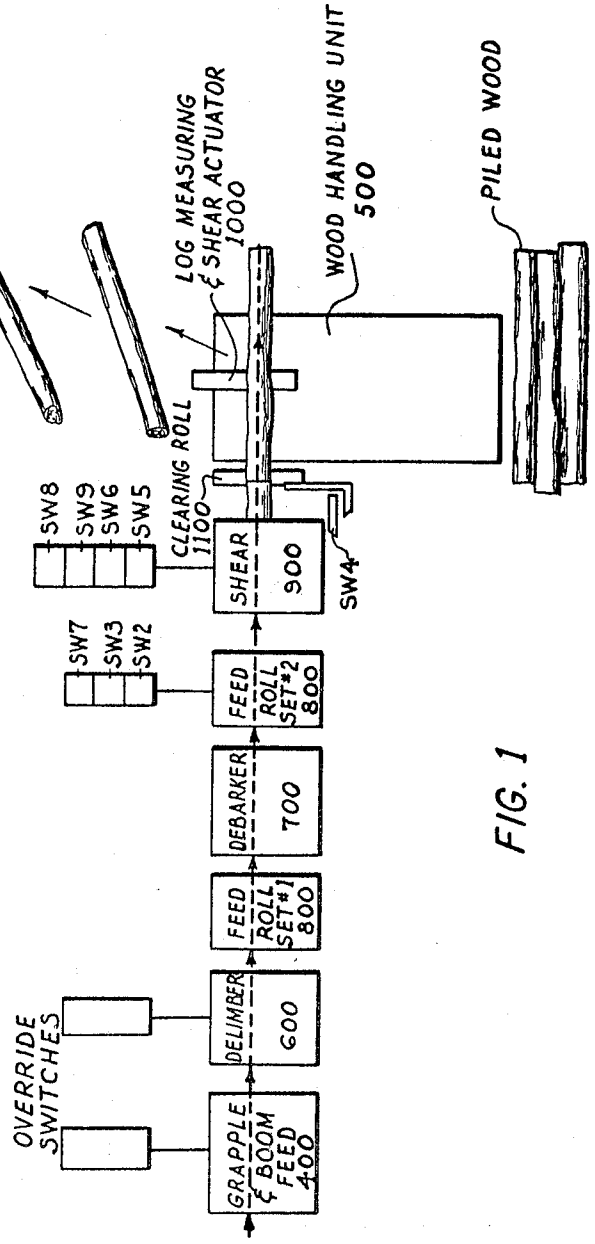

LOG MEASURING & SHEAR ACTUATOR 1000
WOOD HANDLING UNIT 500
PILED WOOD
SW8
SW9
SW6
SW5
CLEARING ROLL 1100
SHEAR 900
SW4
SW7
SW3
SW2
FEED ROLL SET#2 800
DEBARKER 700
FEED ROLL SET#1 800
DELIMBER 600
OVERRIDE SWITCHES
GRAPPLE & BOOM FEED 400

FIG. 1

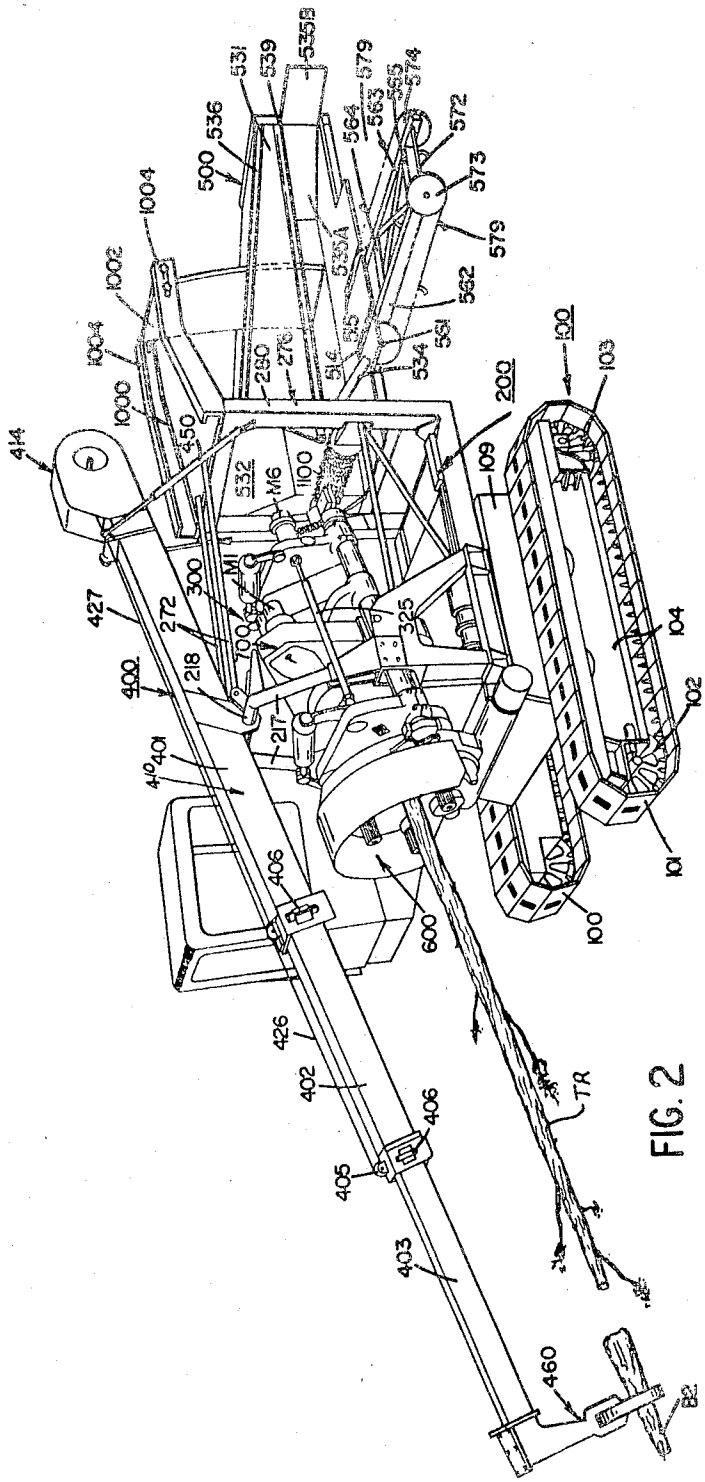

531
539
535B
579
574
555
563
564
572
536
500
573
1004
579
1002
535A
562
1004
591
534
514
275
290
1000
450
200
100
103
414
532
M6
1100
109
M1
300
427
272
325
104
700
218
400
102
217
401
406
600
100
101
426
402
406
TR
405
403
460

FIG. 2

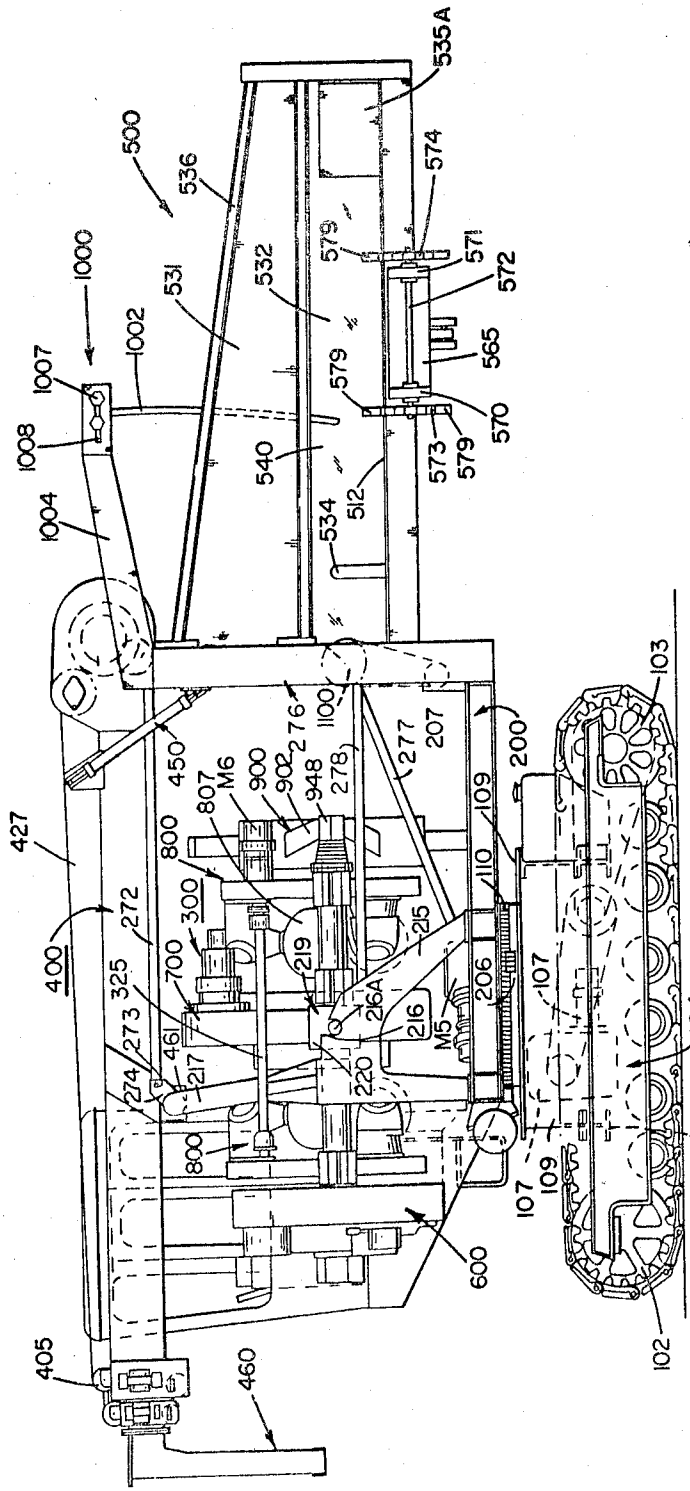

535A
500
536
574
1000
579
571
572
531
532
1002
579
565
1007
1008
570
573
579
540
512
534
1004
103
100
276
277
207
200
450
M6
900
902
948
278
807
109
427
800
110
272
300
215
400
219
206
107
325
700
26A
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M5
104
273
461
217
274
220
800
109
107
105
600
405
460
102

FIG. 3

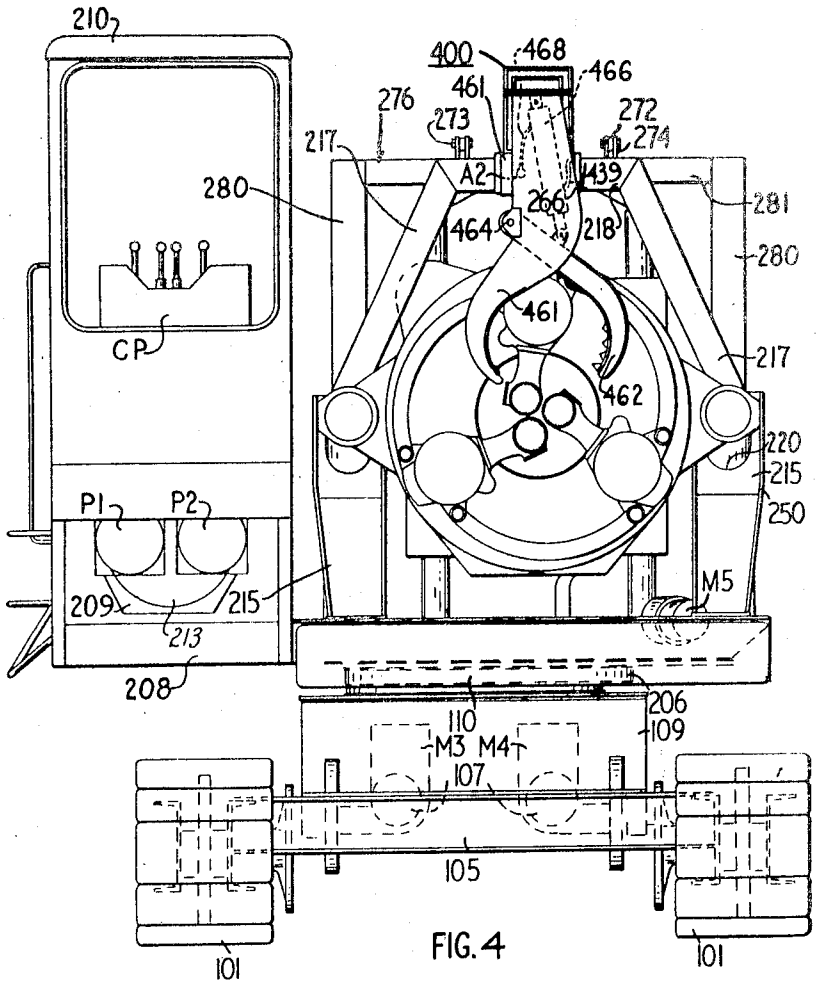

210
400
468
466
461
276
273
272
274
217
A2
439
280
266
281
464
218
280
461
CP
217
462
220
215
250
P1
P2
M5
209
215
213
208
206
110
109
M3 M4
107
105
101
101

FIG. 4

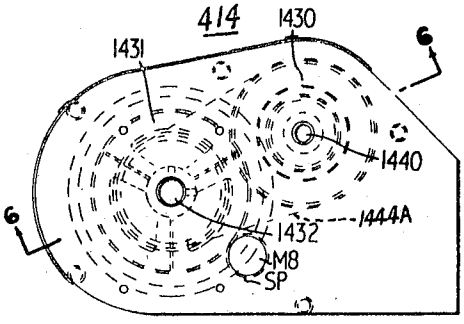

414
1430
1431
6
1440
6
1444A
1432
M8
SP

FIG. 5

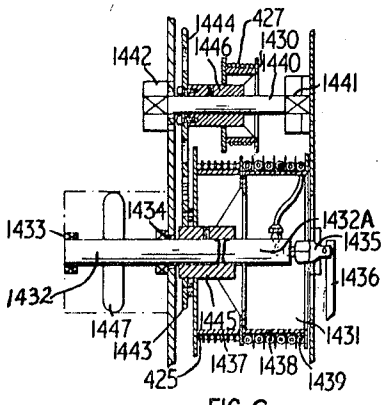

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427
1446
1430
1442
1440
1441
1434
1433
1432A
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1436
1432
1447
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1443
1437
1438
425
1439

FIG. 6

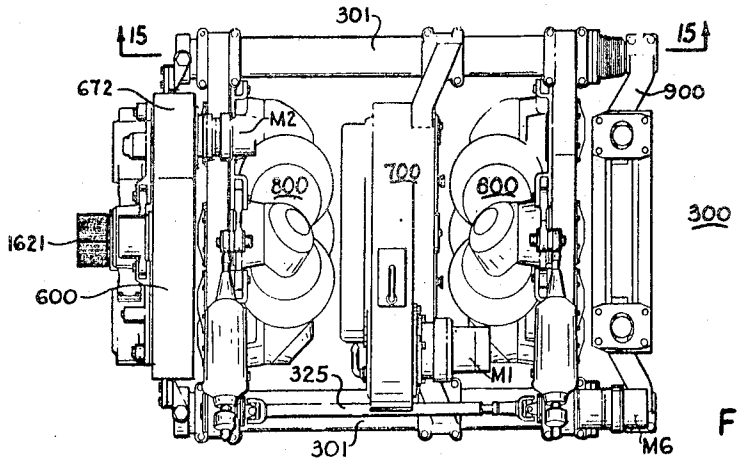

301
15
15
672
900
M2
800
700
800
300
1621
600
325
M1
301
M6

FIG. 7

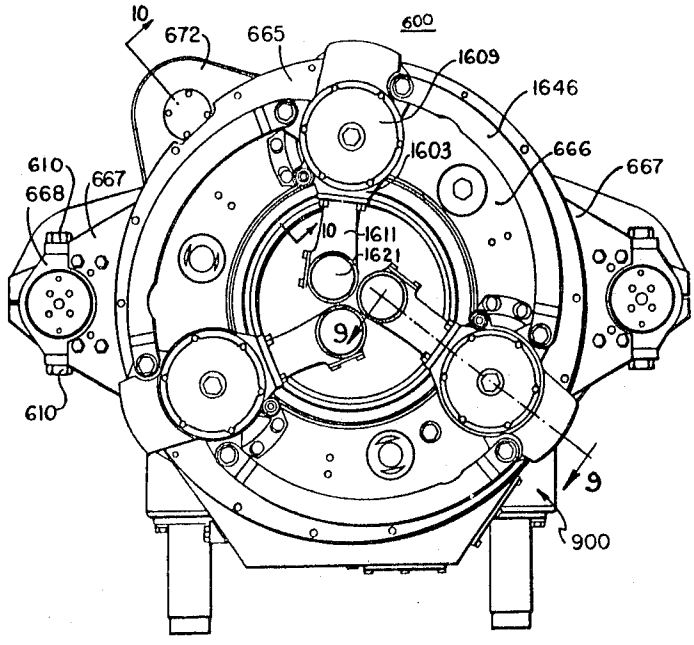

10
672
665
600
1609
1646
1603
666
667
610
668
667
10
1611
1621
9
610
9
900

FIG. 8

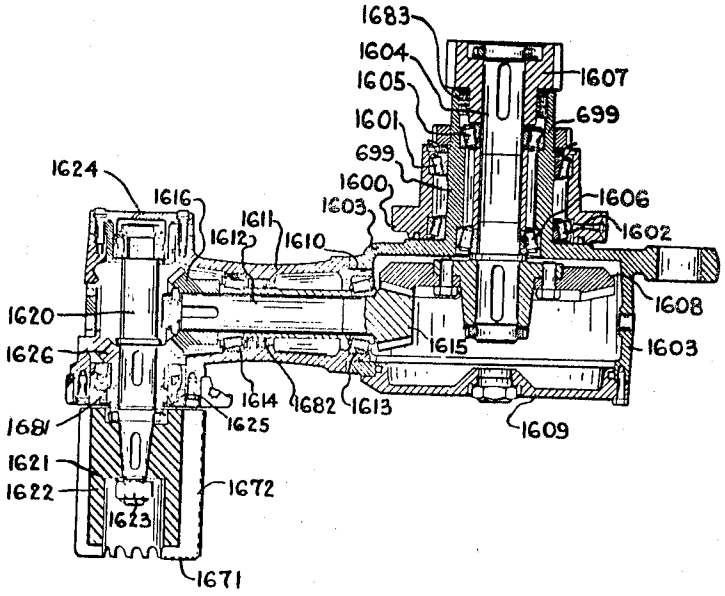

1683
1604
1605
1607
1601
699
699
1600
1603
1606
1602
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FIG. 9

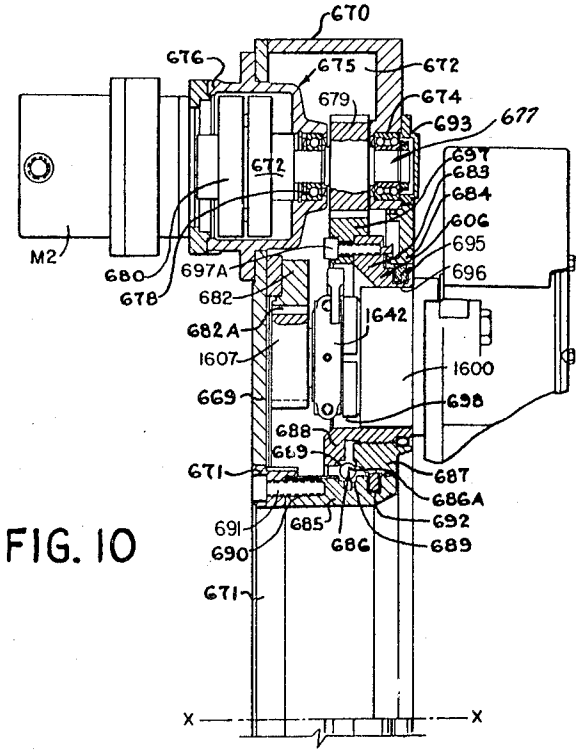

670
676
675
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679
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693
677
697
683
684
606
695
696
672
M2
680
697A
678
682
682A
1607
669
1642
1600
698
688
669
671
687
686A
691
685
692
690
686
689
671
X
X

FIG. 10

FIG. 11

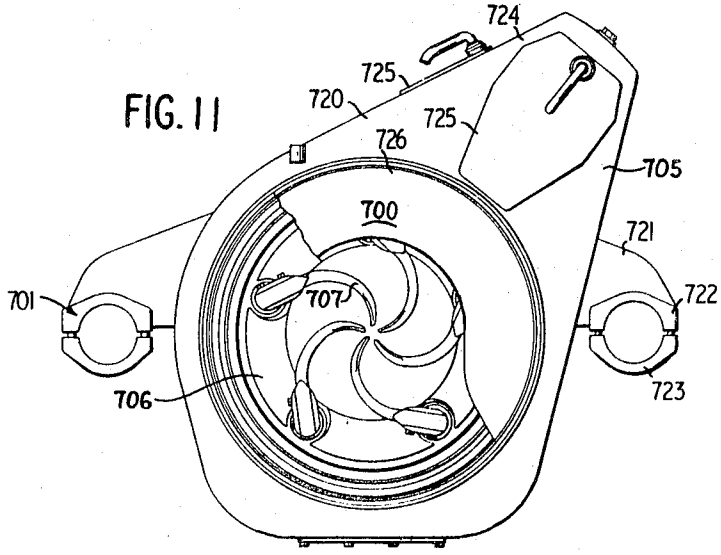
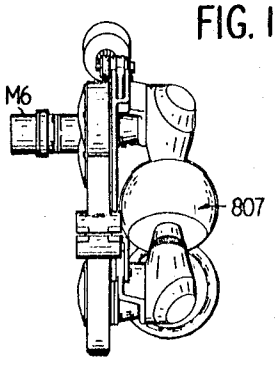


FIG. 12



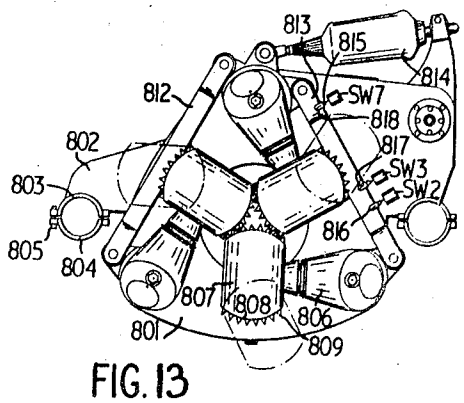


FIG. 13

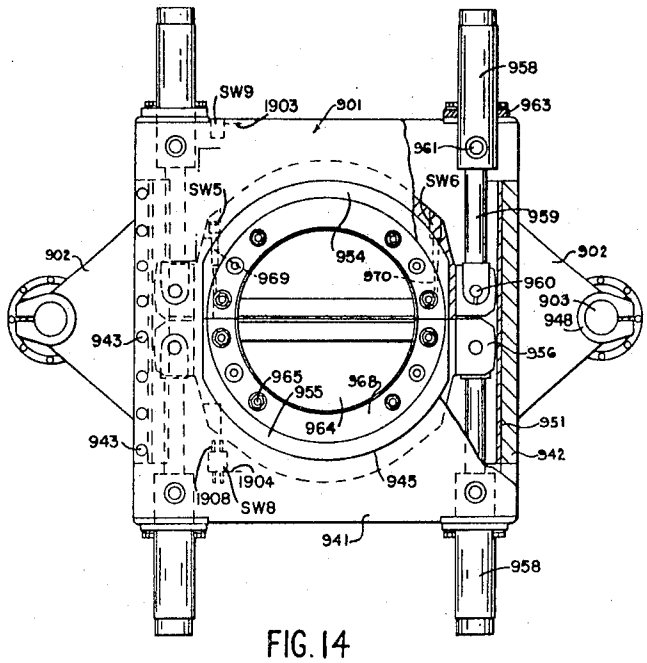

SW9
1903
901
958
963
961
SW5
SW6
959
902
954
969
970
960
903
948
943
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968
964
951
943
942
1904
1908
SW8
945
941
958

FIG. 14

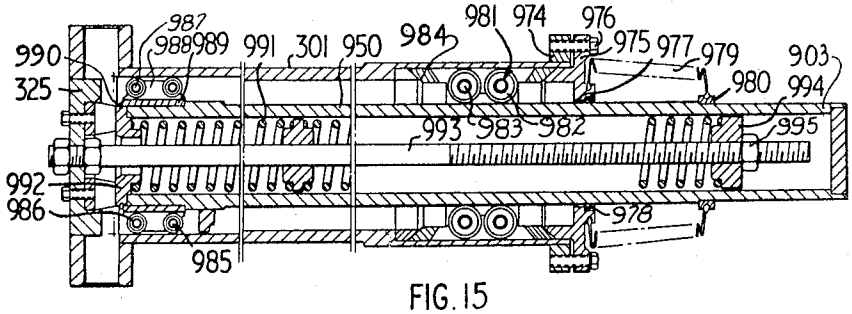

987
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301
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974
976
975
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978
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FIG. 15

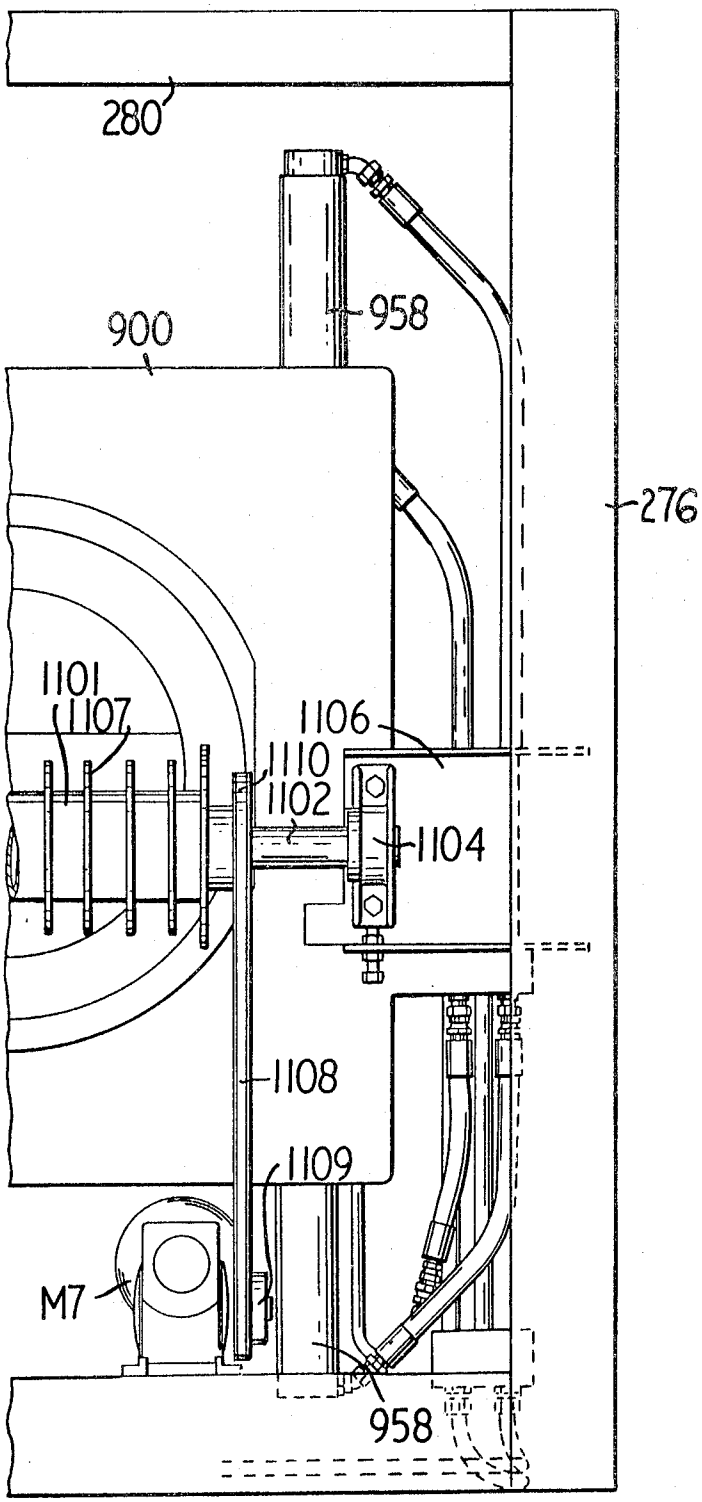


FIG. 16

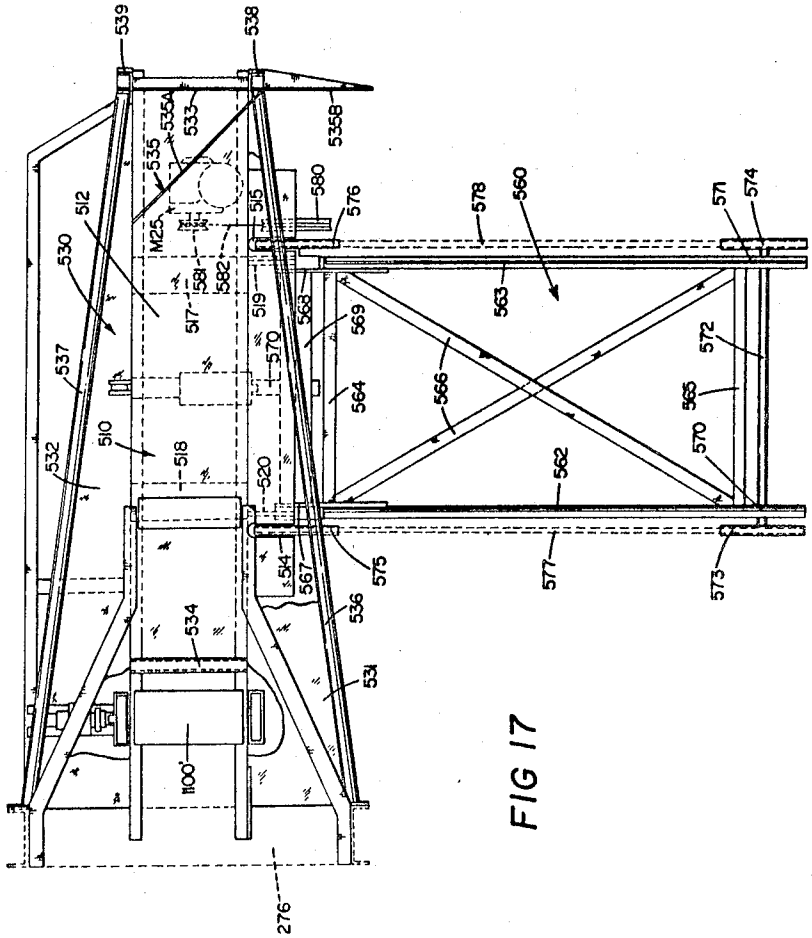

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512
M25
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519
568
569
572
537
570
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567
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577
573
534
536
531
1100
276

FIG 17

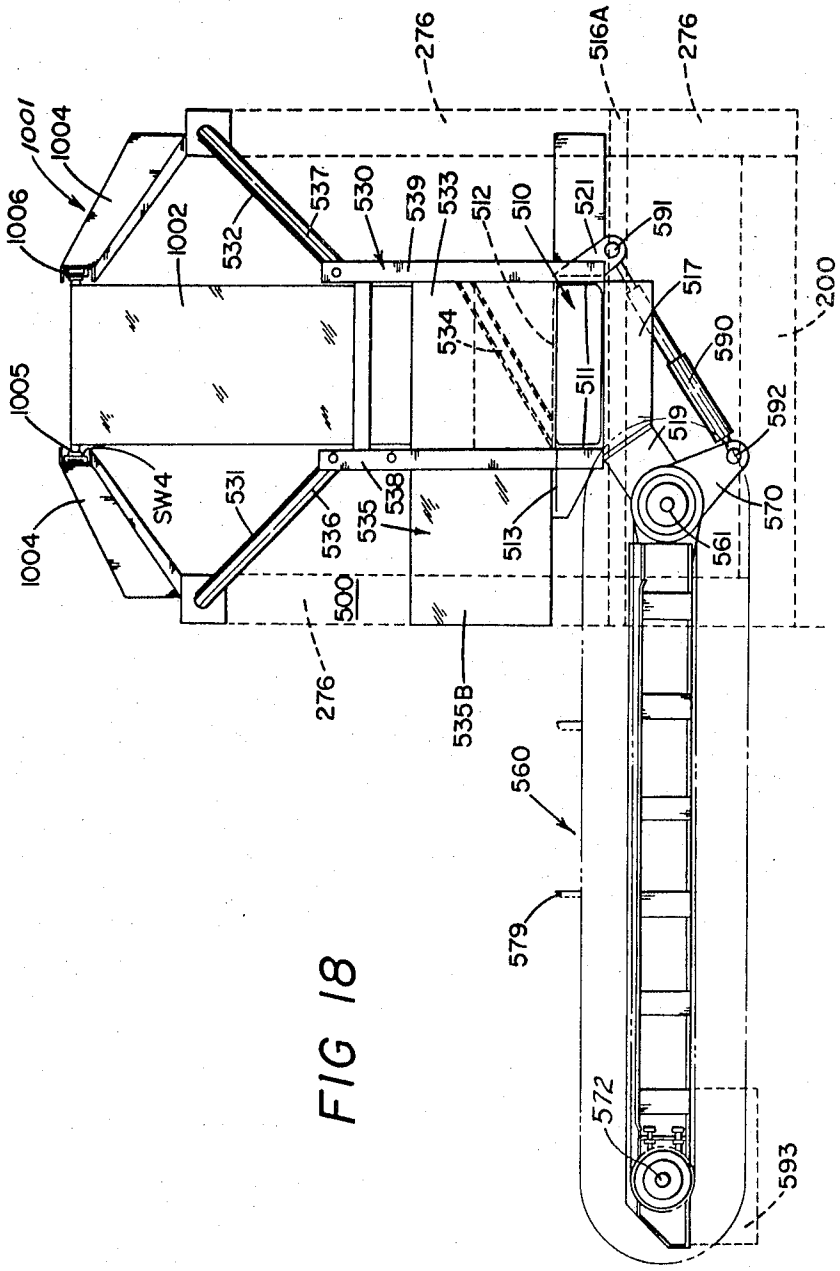

276
516A
276
1001
1004
1006
1002
532
537
530
539
533
512
510
521
591
517
200
534
590
1005
511
519
592
SW4
531
538
535
536
513
561
570
1004
500
276
535B
560
579
572
593

FIG 18

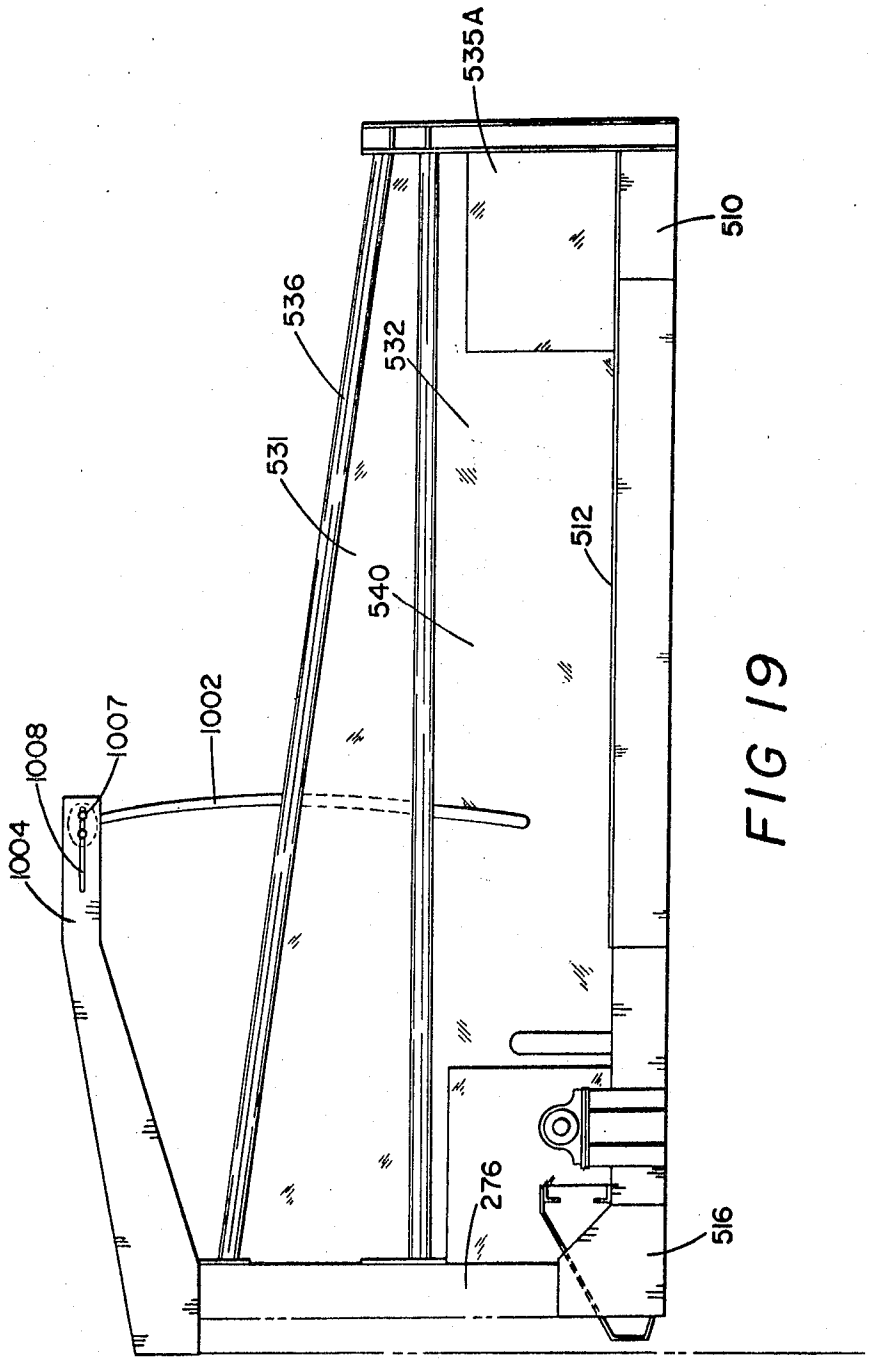


FIG 19

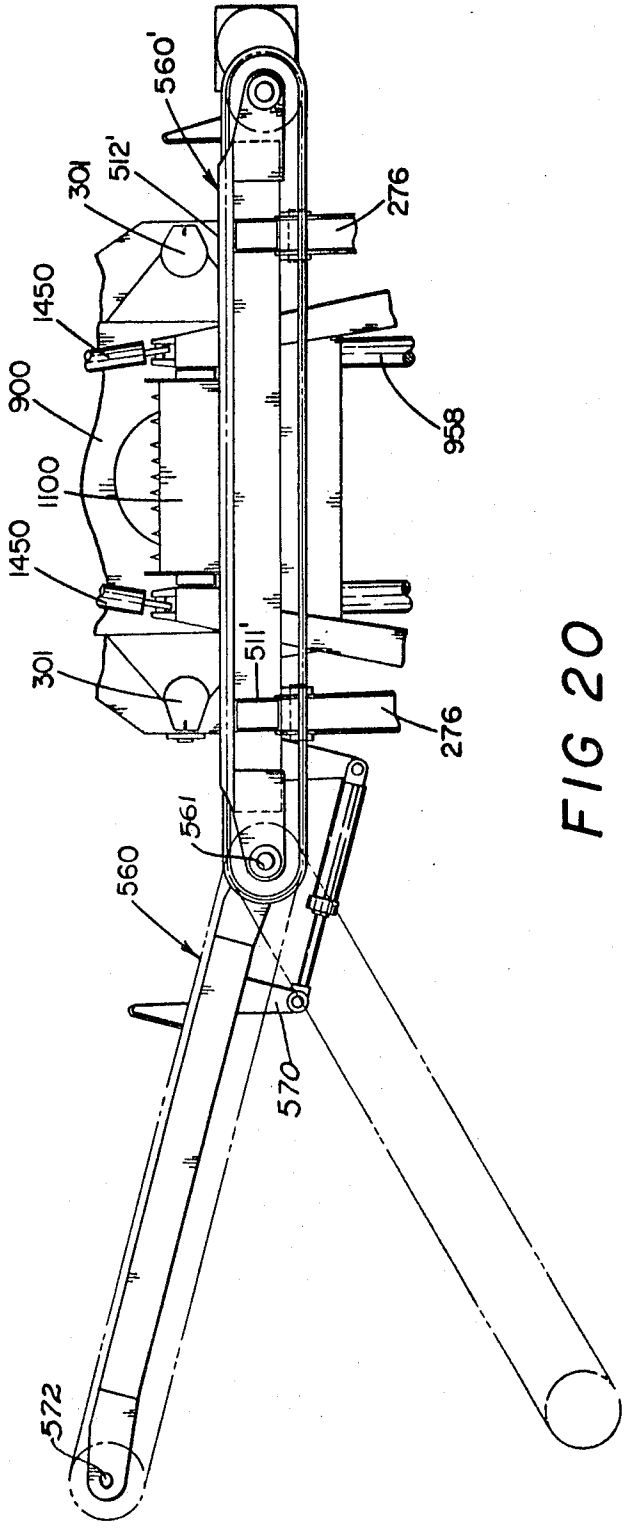

560'
512'
301
276
1450
900
958
1100
1450
511'
301
276
561
560
570
572

FIG 20

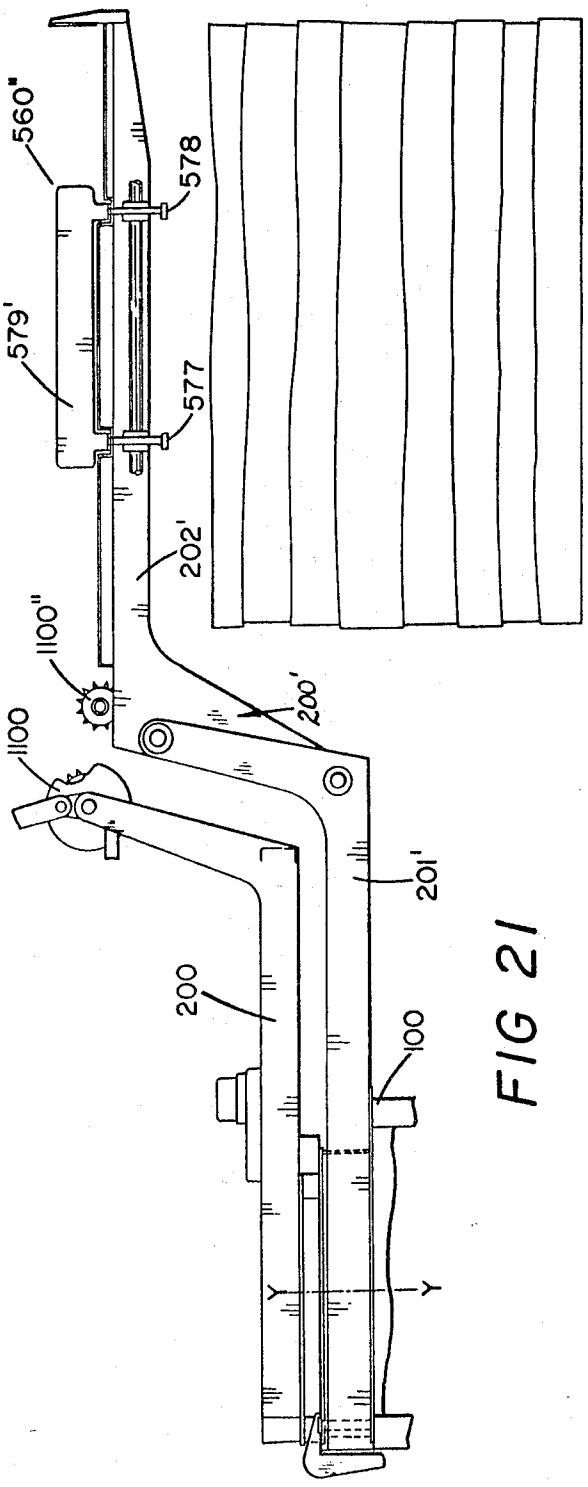


FIG 21

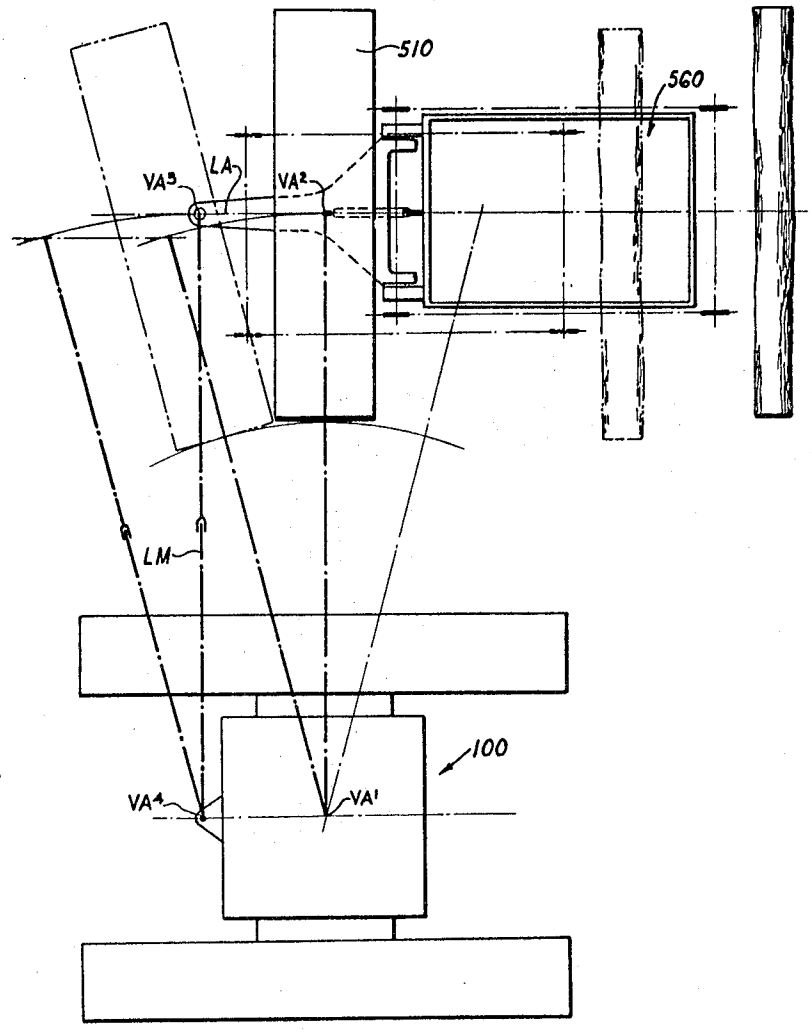


FIG. 22

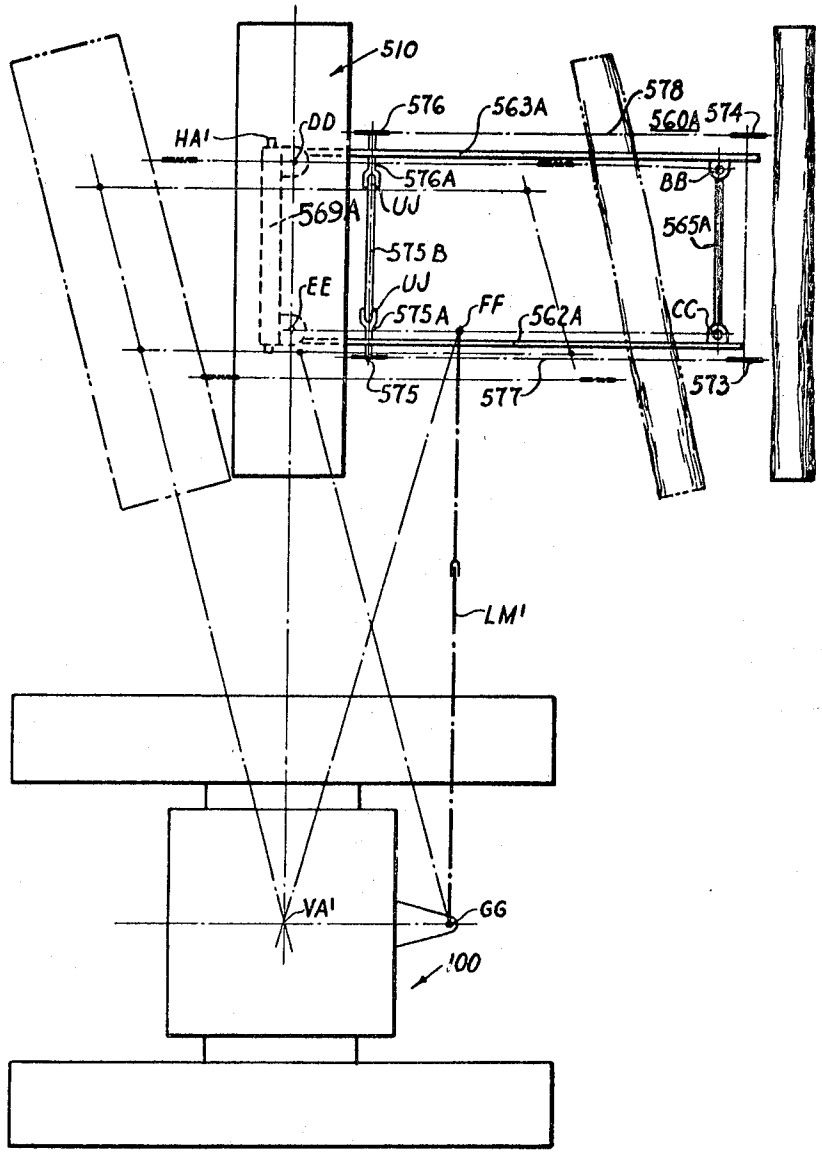

510
576
563A
578
560A
574
HA'
DD
576A
UJ
BB
569A
565A
575 B
UJ
EE
575A
FF
562A
CC
575
577
573
LM'
VA'
GG
100

FIG. 23

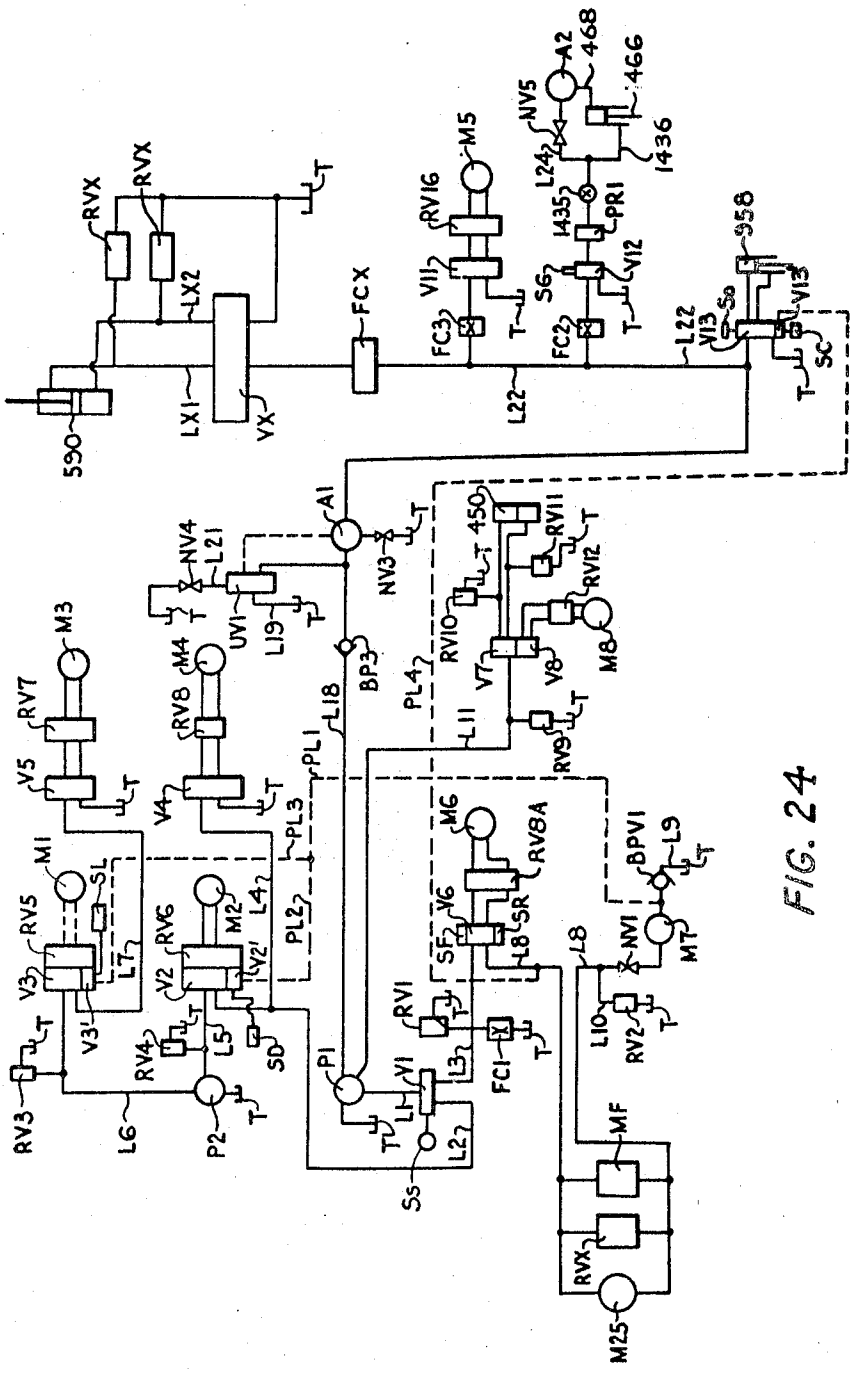

RVX
RVX
LX2
LX1
VX
590
T
FCX
RV16
M5
VII
FC3
T
L22
S6
FC2
T
V12
L24
NV5
A2
468
466
1436
1435
PR1
958
V13
So
V13
SC
T
L22
A1
NV3
T
450
RV11
RV12
M8
V8
V7
RV10
RV9
T
NV4
L21
UV1
L19
T
BP3
PL4
L11
L18
PL1
M3
RV7
V5
T
M4
RV8
V4
T
PL3
M1
RV5
SL
L7
V3
V3'
T
M2
RV6
V2
V2'
L4
PL2
L5
SD
RV4
RV3
L6
P2
T
P1
T
L1
V1
L2
Ss
RV1
T
L3
FC1
T
M6
RV8A
V6
SF
SR
L8
L8
BPV1
L9
T
NV1
MT
L10
RV2
T
MF
RVX
M25

FIG. 24

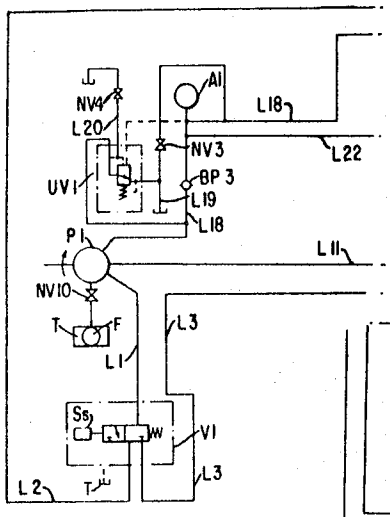


FIG. 25

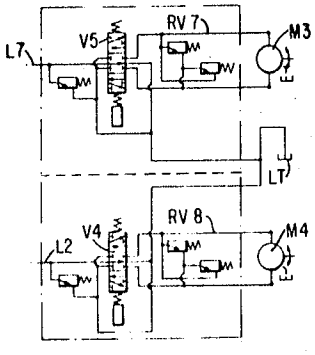


FIG. 26

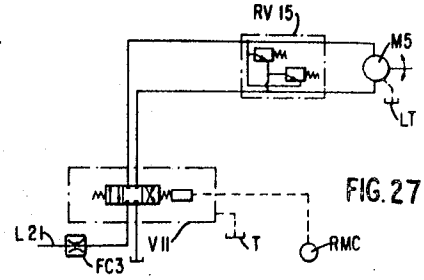


FIG. 27

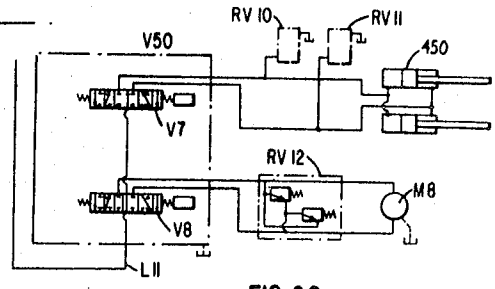


FIG. 28

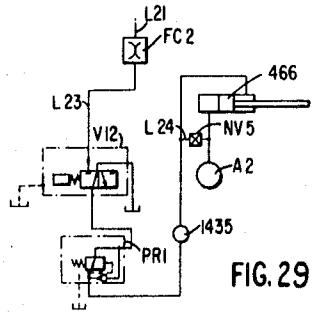


FIG. 29

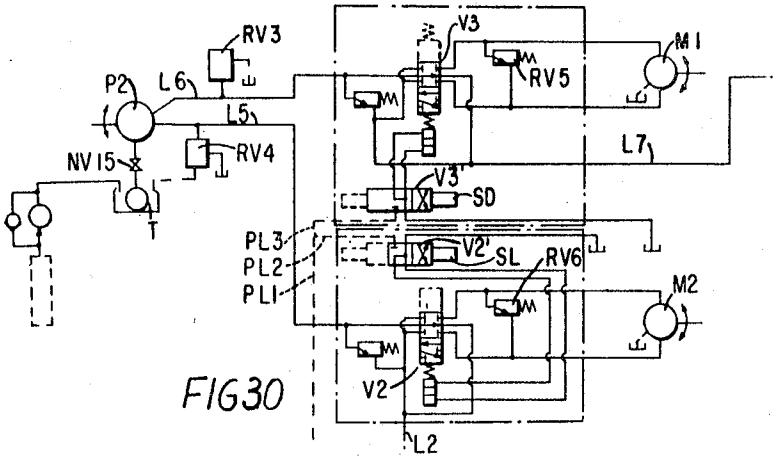


FIG30

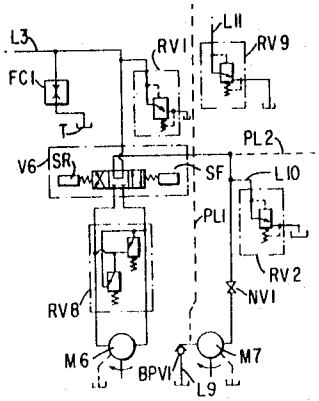


FIG. 31

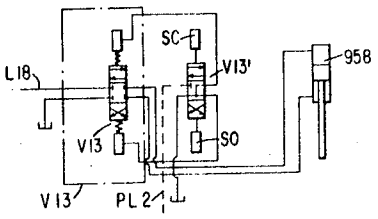


FIG. 32

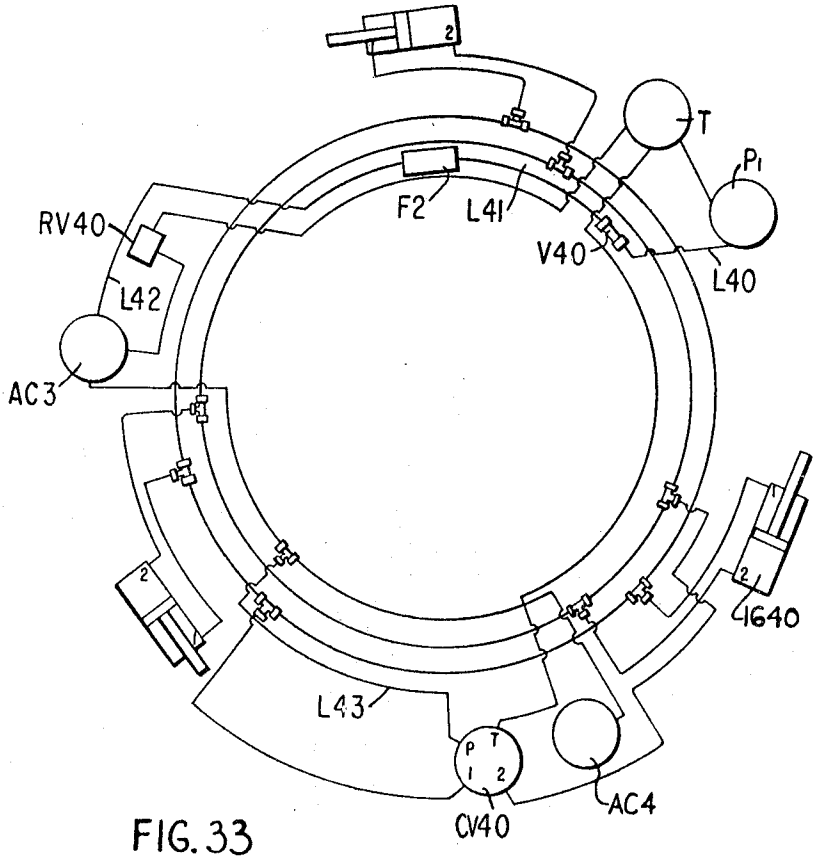

T
P1
F2
L41
V40
L40
RV40
L42
AC3
1640
L43
P T
1 2
CV40
AC4

FIG. 33

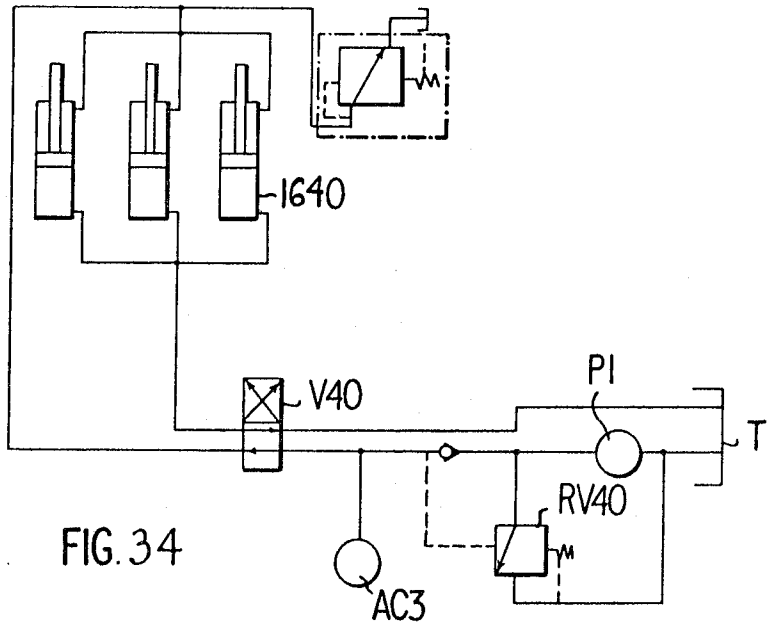

1640
V40
PI
T
RV40
AC3

FIG. 34

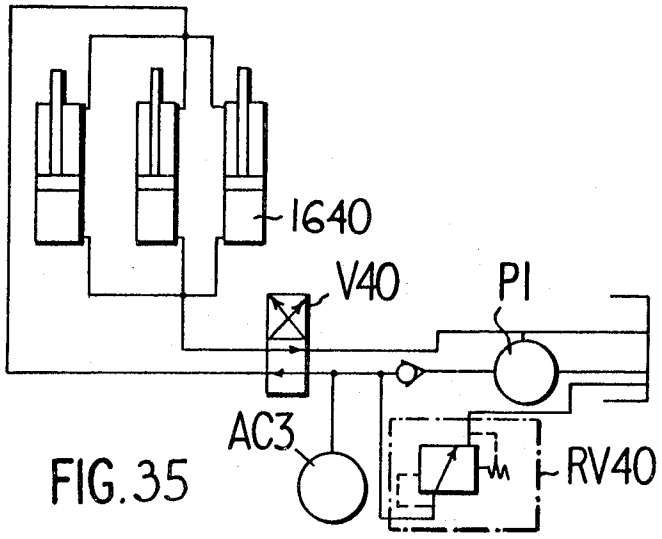

1640
V40
PI
AC3
RV40

FIG. 35

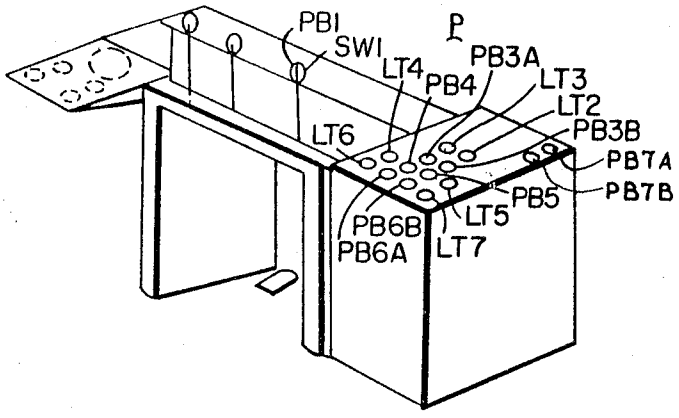

PBI
SWI
P
LT4
PB4
PB3A
LT3
LT2
PB3B
LT6
PB7A
PB7B
PB5
LT5
PB6B
PB6A
LT7

FIG. 36

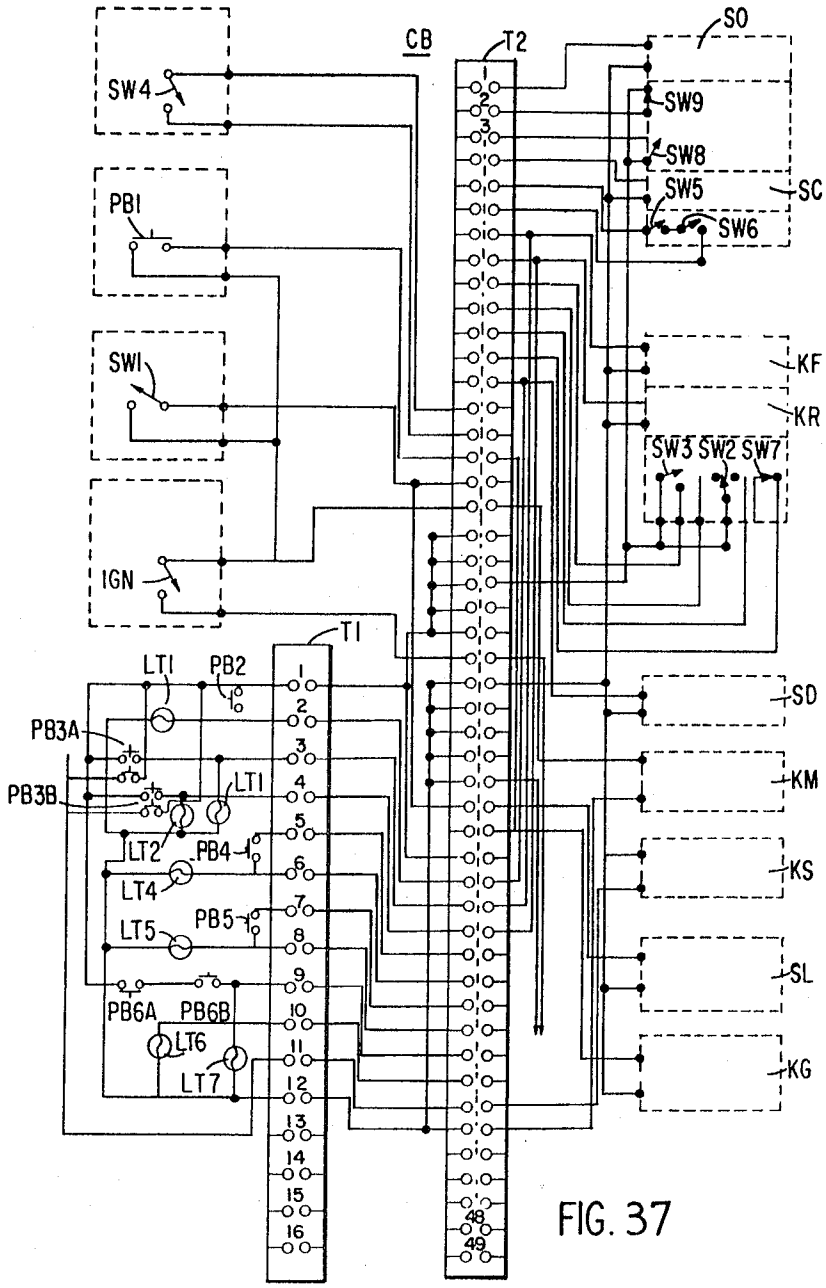

CB
T2
SO
SW4
SW9
SW8
SW5
SC
SW6
PB1
KF
KR
SW1
SW3 SW2 SW7
IGN
T1
LT1
PB2
SD
PB3A
KM
PB3B
LT1
LT2
PB4
KS
LT4
PB5
LT5
SL
PB6A
PB6B
LT6
KG
LT7
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
48
49

FIG. 37

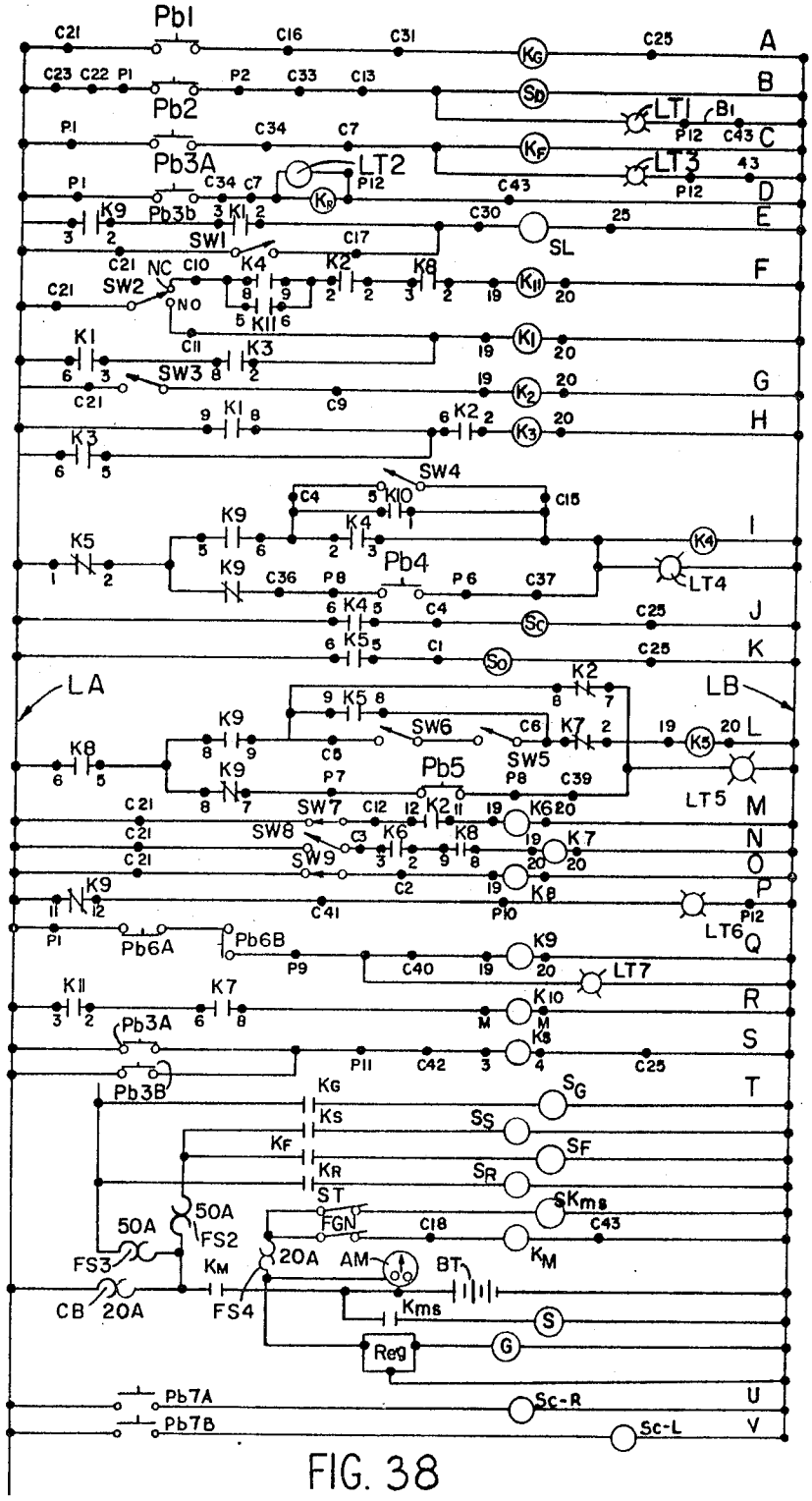

Pb1
Pb2
Pb3A
Pb3b
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW8
SW9
Pb4
Pb5
Pb6A
Pb6B
Pb3B
Pb7A
Pb7B
LT1
LT2
LT3
LT4
LT5
LT6
LT7
SL
LA
LB
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
50A
FS2
FS3
FS4
CB 20A
20A
AM
BT
FGN
ST
Reg
Pb7A
Pb7B

FIG. 38

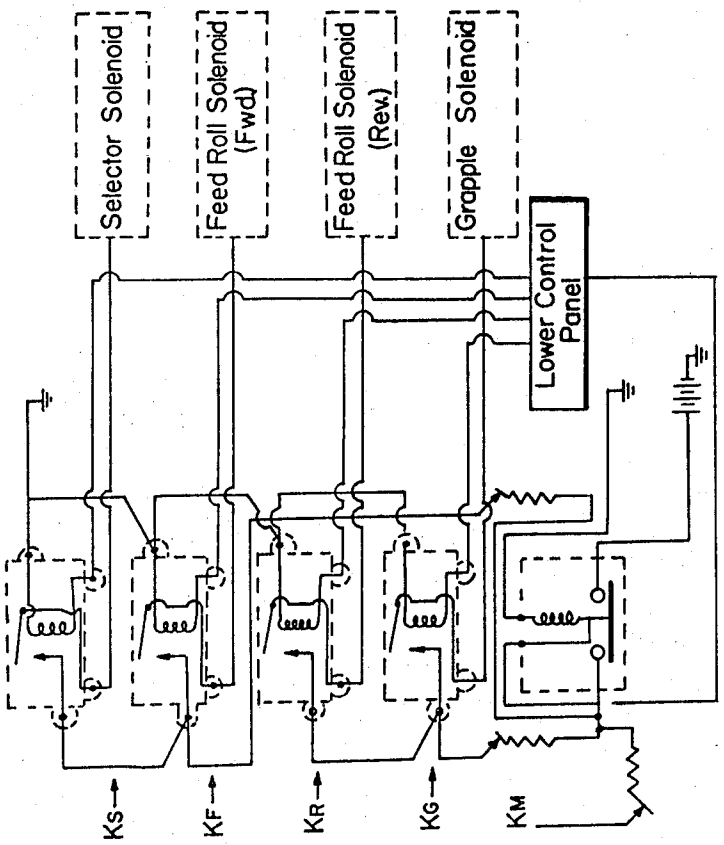

Selector Solenoid
Feed Roll Solenoid (Fwd)
Feed Roll Solenoid (Rev.)
Grapple Solenoid
Lower Control Panel
KS
KF
KR
KG
KM

FIG. 39

MOBILE TREE-PROCESSING MACHINE

This invention relates to improvements in the art of processing raw timber and more particularly to an improved mobile vehicle for processing raw timber and to an improved method of handling raw timber to process the same.

In a timber operation of the type to which this invention particularly relates, trees are felled in the forest, the limbs removed and the trunk or bole is cut into predetermined lengths, called bolts, which are then transported to a mill. To a large extent, the removal of the limbs has been preformed by hand after the tree has been felled. At the mill the bark has been removed, if necessary, and the processed logs are then ready for their intended later use.

In many operations, or later use of the bolts, it is not necessary to remove the bark from the felled tree. Such operations include the use of wood as saw logs. In other operations, for example, where the bolts are used for pulpwood, the bark cannot be used and, accordingly, must be removed. As mentioned previously, this normally has been done as a separate operation and usually at the mill.

The procedure in the past has necessitated several independent steps usually carried out manually or by manually operated individual machines. For example in processing wood for pulp, after the tree has been felled, the felled tree was passed through the processing steps first to remove the limbs, second, to cut the delimbed tree into sections, and third, to remove the bark from the delimbed tree and cut tree sections. Mobile equipment, for example such as that disclosed in the Busch U.S. Pat. No. 3,059,677 issued Oct. 23, 1962, is capable of performing these operations but there is not included in such equipment any suitable or convenient device for handling the processed trees and furthermore such known equipment cannot carry out such operations simultaneously on the same log in a sequence of operations and further deliver the processed logs to a selected location.

Other known equipment consists of a series of independent pieces of equipment movable only with great difficulty and by virtue of being independent the various pieces require individual repositioning and realignment with each move. Movement of such equipment accordingly becomes a major operation and therefore cannot be termed "mobile." Processing by independent operations is time consuming and thus costly. Furthermore the independent pieces of equipment normally result in performing the various operations independent of one another and by independent operations is meant that only one operation is being performed on one single tree trunk at one time.

It is an object of the present invention to provide an improved apparatus and method of processing trees.

It is a further principal object of the present invention to provide handling means for processed trees for use with a mobile piece of equipment used in processing trees.

In accordance with one aspect of the present invention there is provided a raw timber processing technique which includes, (a) handling trees to feed the same in successive relation to processing units mounted on a mobile vehicle, (b) removing, in sequence, the processed trees from the processing unit and, (c) depositing the processed trees in stacked relation at a selected location.

In accordance with a further aspect of the present invention there is provided a processing technique which includes, (a) maneuvering a vehicle to an area of felled trees, (b) feeding the felled trees, in sequence, to processing units mounted on the vehicle and (c) piling the processed trees, discharged from the processing unit, in a selected location by a log-handling unit mounted on the vehicle.

In accordance with a still further aspect of the present invention there is provided a method of processing raw timber which comprises, (a) maneuvering a mobile processing machine, having processing units thereon, to an area of trees to be processed, (b) feeding, in sequence, trees to the processing units, (c) processing said trees in sequence, (d) conveying, in sequence, said processed trees from said processing unit and (e) selectively varying the vertical position of the discharge end of said conveyor to stack said processed trees in a selected position.

In accordance with a further aspect of the present invention there is provided in a machine for processing raw timber which includes tree-processing units, mounted on a mobile vehicle, to remove the limbs from a felled tree and/or sever the delimbed tree and/or debark the tree, the improvement comprising: a driven discharge conveyor mounted on said vehicle and disposed adjacent a processed tree discharged from the processing unit to receive the same and deliver said processed tree to a selected location.

In accordance with a still further aspect of the present invention there is provided a processing machine comprising in combination:

a. a mobile vehicle;
b. feed means mounted on said vehicle for feeding a felled tree along a selected path;
c. at least one processing unit, mounted on said vehicle and located in said feed path, said processing unit having a discharge end whereat the processed tree emerges; and
d. conveyor handling means mounted on said vehicle to deliver the processed tree to a selected location.

In accordance with a still further aspect there is provided a machine for processing raw timber comprising in combination

a. a mobile carrier,
b. at least one processing unit mounted on said carrier and consisting of a delimber unit and/or debarker unit and/or a shear unit,
c. feed means propelling, in sequence, trees through said processing unit to process the trees and
d. a log-handling unit, secured to said carrier and disposed at a position adjacent processed trees discharged from the processing unit to receive the same, said log-handling unit including a conveyor and means selectively to vary the position of the discharge end of the conveyor and thereby facilitate depositing the processed trees in a selected location.

In accordance with a further aspect of the present invention there is provided a processing machine comprising in combination

a. a first support;
b. a second support pivotally mounted on said first support to pivot selectively about a substantially vertical axis;
c. tree-processing units, carried on said second support and adapted to remove limbs and/or bark and/or sever a tree, said tree-processing units having a discharge end;
d. conveyor discharge means secured to one of said first or second supports adjacent said discharge end of the tree-processing means to facilitate discharging the processed tree from said processing machine and
e. means, responsive to movement of said second support, effecting movement of the conveyor discharge and in a direction opposite to the pivotal movement of the second support about said vertical axis.

The invention is illustrated by way of example in the accompanying drawings wherein:

FIG. 1 is a block flow diagram of processing raw timber in accordance with the present invention,

FIG. 2 is an oblique view of a mobile tree-processing machine constructed in accordance with the present invention,

FIG. 3 is a side elevational view of the machine illustrated in FIG. 2,

FIG. 4 is a partial front elevational view of the machine illustrated in FIGS. 2 and 3,

FIG. 5 is a partial side elevational view of the boom extending and retracting means,

FIG. 6 is a section along line 6—6 or FIG. 5,

FIG. 7 is a top plan view of the processing units and feed rolls secured to a pair of beams,

FIG. 8 is a front elevational view of processing units illustrated in FIG. 7.

FIG. 9 is a detailed cross-sectional view, of one of the delimber arm assemblies having a cutterhead mounted thereon, taken along section 9—9 of FIG. 8.

FIG. 10 is a cross-sectional view of the delimber stator and rotor in an assembled position including the rotor drive and is taken substantially along section 10—10 of FIG. 8.

FIG. 11 is a front elevational view of the debarker unit.

FIG. 12 is a side elevational view of a set of feed rolls.

FIG. 13 is a front elevational view of FIG. 12.

FIG. 14 is a partial sectional, rear elevational view of the shear unit.

FIG. 15 is a cross section, of a beam for mounting the processing units, taken substantially along section 15—15 of FIG. 7.

FIG. 16 is a partial rear elevational view of the shear and an off-feed speedup roll located therebehind.

FIG. 17 is a top plan view of the log-handling or wood disposal unit.

FIG. 18 is a rear elevational view of the log-handling unit in FIG. 17.

FIG. 19 is a side elevational view of the log guide portion of the log-handling unit illustrated in FIGS. 17 and 18.

FIG. 20 is a partial elevational view of an alternative arrangement of the log-handling unit.

FIG. 21 is a partial elevational view of a still further alternative log-handling unit.

FIG. 22 is a diagrammatic illustration of a modification relating to the manner in which the log-handling unit is connected to the vehicle.

FIG. 23 is a diagrammatic illustration of a still further modification,

FIG. 24 is a partial block and schematic illustrating the overall hydraulic system for the processing machine,

FIG. 25 is a schematic of the pump and pressure release valve assembly,

FIG. 26 is a schematic of the hydraulic system of the vehicle track motors and controls therefore,

FIG. 27 is a schematic of the hydraulic system for the slewing motor,

FIG. 28 is a schematic of the hydraulic system for the boom lift and winch motor,

FIG. 29 is a schematic of the hydraulic system for the grapple of the winch,

FIG. 30 is a schematic of the hydraulic system for the delimber and debarker motors,

FIG. 31 is a schematic of the hydraulic system for the feed and clearing roll,

FIG. 32 is a schematic of the hydraulic system for the shear cylinders,

FIG. 33 is a schematic of the hydraulic system for the delimber,

FIG. 34 is a further schematic of the hydraulic system for the delimber,

FIG. 35 is an alternative arrangement of the hydraulic system illustrated in FIG. 34,

FIG. 36 is an oblique diagrammatic illustration of the operator control area having a panel box enclosing a portion of the electrical circuitry,

FIG. 37 is a partial block and schematic illustration of the electrical system,

FIG. 38 is an electrical ladder diagram illustrating the electrical circuitry for the machine, and,

FIG. 39 is a schematic of a group of relays illustrating their interrelationship.

GENERAL ARRANGEMENT OF PROCESSING MACHINE

Referring generally to the drawings, there is provided a machine for processing felled trees wherein such machine includes tree-handling means in order that a selected prefelled tree may be picked up from an array of prefelled trees and be fed along a selected path. The tree-handling means preferably consists of a boom-and-grapple assembly adapted to grasp and pick up a tree to introduce the same into the first of a series of processing units in tandem alignment mounted on the machine and further means such as feed rolls or the like to propel the tree through the processing units. The processing units are adapted to delimb or to debark or to shear or to carry out all such processes or combinations thereof in sequence on the tree being fed therethrough. The tree-handling means may consist of a telescopically extendable and retractable boom with article-engaging means mounted thereon adjacent the forward end of said boom to engage and to elevate at least one end of the selected tree and feed such elevated end directly into the processing unit and in this way the tree is introduced into a predetermined feed path. The processing units may consist of a delimber, a debarker, or a shear or any combination thereof together with feed rolls. The entire assembly of the same being mounted whereby they may pivot about a substantially horizontal axis such that the processing units maintain alignment with a changing feed path caused by the trailing end of the tree initially being supported on the ground but having its inclination to the horizontal axis continuously changing while passing through the processing units.

Included on the machine is a log-handling unit whereby the processed logs are delivered in sequence to a selected location and deposited in stacked relation.

The article-engaging member on the boom may consist of a grapple having a pair of tong members one of which is pivotally secured to and projects downwardly from the boom and other of which is pivotally secured to the downwardly projecting tong. Alternatively both of the tong members may be pivotally secured to the boom. In either event each tong member preferably terminates in a terminal end portion turned inwardly toward the terminal end of the other tong member.

One of the processing units consists of a delimber having a plurality of cutterheads engageable with the tree to delimb the same, the cutterheads being mounted on a member in circumferentially spaced relation about said tree. The mounting member is rotatable about an axis substantially coincident with the longitudinal axis of said tree. The cutterheads are positively driven and movable toward and away from the tree by being mounted on arms which can oscillate about an axis generally parallel to the rotation of the mounting member.

A further processing unit consists of a debarker, of the type including a plurality of tool members engageable with the tree to remove said bark by scraping action or by cambium fracture. The tool members are mounted on a member and disposed circumferentially about said tree, such mounting member being rotatable about an axis substantially coincident with the longitudinal axis of said tree. The tool members are generally arcuate arms having tips engageable with the tree, each arm being pivotally mounted and biased inwardly so as to remain in contact with the tree during the processing operation.

The trees are propelled through the processing units by one, and possibly two or more sets of feed rolls, each set being of the type including a plurality of driven rollers each having a circumferential surface grippingly engaging the tree. At least one of the rollers is biased inwardly toward said tree and they are disposed about the tree in a generally triangular arrangement clampingly to engage the tree. The rollers also serve to restrain or prevent the tree from rotating about its longitudinal axis while the tree is being processed.

A further processing unit includes mechanism for cutting the trees into logs. The cutting mechanism consists generally of a pair of relatively movable cutting knives, a housing for said knives and means for moving at least one of said knives toward and away from an axial path to cut the tree into logs. The housing is mounted in such a manner as to allow the housing and knives to move axially along with the tree while the knives are in engagement therewith and means for returning the housing to its initial position when said knives are moved away from said tree.

The log-handling unit includes a conveyor located at the discharge end of the last processing unit and is positioned to deliver the processed logs to a selected location. The conveyor includes a portion which is movable permitting selective variation in positioning the discharge end. The conveyor accordingly may be raised as the log pile increases in height and the logs are thus discharged at roughly the same relative vertical position with respect to those on the pile in a selected range of heights of the pile.

To facilitate handling the processed trees there may alternatively or additionally be added means downstream of the processing units for removing the processed tree from the machine. The means preferably includes a roll rotatably mounted on said machine and having the surface thereof disposed for rolling contact with the processed tree. The roll, generally referred to as a speedup roll, is preferably driven and has an outer surface tractively engageable with the processed tree.

In the event delimbing is unnecessary, as in the case where inconsequential limbs are present, the tree bole can be passed directly into the above-specified debarker. Various combinations may be utilized, the basic requirement being that there is provided handling apparatus for feeding the trees in sequence to processing units, means to process the trees and log-handling apparatus for sequentially removing the processed trees and selectively stacking the same. Preferably the entire assemblage is mounted on a mobile vehicle. A debarker may be substituted for the delimber and these two units may be used in combination or various subcombinations.

It will be seen from the detailed description to follow there is a plurality of processing units disposed between and detachably secured to a pair of spaced rigid beams to provide a rigid subassembly. The processing units are disposed in axial alignment parallel to the length of said beams in tandem relation. Because of the manner in which the processing units are detachably secured to the beams, they may be slid therealong for removal, or they may be so secured that they may be individually and selectively removed from the beams without necessarily removing the nonselected unit.

In positioning the processing units on the beams, the center of gravity should preferably be upstream of the pivot axis of said subframe assembly but also permit the inclination of the feed path axis to change as the center of gravity of the processing units, together with the tree, changes as the tree proceeds downstream of the pivot axis of said subframe assembly.

Referring now in details to the drawings, the mobile processing machine includes a tractor assembly **100** having a frame assembly **200** mounted thereon to pivot about a vertical axis. A subframe assembly **300** is mounted on the frame **200** in such a manner as to pivot generally about a horizontal axis, and includes a plurality of tree-processing units to be described in detail hereinafter. Carried upon the upper end of the frame **200** is a boom-and-grapple assembly **400** for engaging a tree and introducing one end thereof directly into the first of the processing units. Also mounted upon the frame **200** at the rear end thereof, is a log-handling unit **500** providing for orderly removal of processed bolts from the last of the processing units and selectively piling such processed bolts. The machine also includes a log-measuring apparatus indicated generally by the reference numeral **1,000**.

The processing units include a delimber **600**, a debarker **700**, and a shear unit **900**. If desired a log-chipping unit may be included. The processing units are mounted on the machine in substantially horizontal tandem alignment such that they perform their processing function simultaneously on a single tree bolt at horizontally spaced positions. A tree bolt being processed passes in sequence through the individual processing units of the combination being used. A plurality of trees are processed in sequence, each tree passing through the machine in a path substantially along the longitudinal axis of the processing units. A grapple **460**, provided with a movable jaw and a fixed jaw, is suspended from the tree end of an extendable and retractable boom **410**. The processing units are detachably fixed to a pair of beams and the entire assembly constitutes the subframe assembly. This subframe assembly, and the boom-and-grapple assembly, are each mounted on the tractor frame **200** and thereby pivot in unison about a generally vertical axis. The boom-and-grapple assembly, if desired, may be mounted to pivot about a vertical axis independent of the processing units. Also the processing units may be mounted in a position fixed relative to the tractor **100**. The boom is further mounted to pivot about a substantially horizontal axis to allow lowering and raising the grapple. Since the tractor unit is movable, the machine can be operated to process felled trees lying on the ground at various locations. The boom is extendable and thus adapted to grab trees outwardly away from the machine to the extent of the reach of the fully extended boom.

The processing machine components **100, 200, 300, 400, 500, 600, 700, 800, 900** and **1,000** will be individually described in detail hereinafter. For convenience of description the left and right end of the machine as viewed in FIGS. **2** and **3** will be referred to respectively as the front and rear end of the machine. The axis extending through the front and rear end will be referred to as the longitudinal axis and the axis normal thereto will be referred to as the transverse axis of the machine.

TRACTOR

The tractor **100** (see FIGS. **2** and **3**) consists of a pair of treads or endless tracks **101** each entraining an idler **102** and a drive wheel **103**. The idler and drive wheels of each tread are journaled respectively adjacent opposed ends of a beam member **104**, the beams **104** being interconnected by cross-members or beams **105**. The idlers are adjustable longitudinally along respective ones of the beams by a mechanism common to track vehicles whereby the tension in the treads may be adjusted. The drive wheels at opposite sides of the machine are driven by respective one of hydraulic motors M3 and M4 through respective ones of a pair of transmission units **107**.

The motors M3 and M4 are driven by a suitable power source mounted upon the frame **200** as will be described hereinafter. Hydraulic motors are preferable, however, electrical motors can be substituted therefor. The motors are controlled individually and thereby means is provided to steer the tractor in moving from one place to another. Obviously a transmission and clutch arrangement, common to track vehicles, may be used for steering and driving.

A platform **109** is secured to and supported by the cross-beams **105**. The platform has a generally horizontal upper surface **109A** and secured thereto is an external ring gear **110**. The ring gear, as will be seen hereinafter, is used for slewing or pivoting the frame **200** about the vertical axis.

The inner part of the ring gear forms one part of a monorace bearing whereby the frame **200** is pivotally mounted upon the tractor unit. The monorace additionally includes an inner ring (not shown) with a plurality of balls or bearings disposed between such ring and the internal surface of the ring gear. The internal ring has an upper surface located vertically above the adjacent surface of the ring gear and the frame **200** is secured to such upwardly projecting portions. The central area of the monorace is open and provides space to receive hydraulic lines leading to various components of the machine. A self-propelled processing machine is preferable and an endless track type of tractor is also preferred to provide such a self-propelled vehicle. The processing machine however may be mounted upon a wheeled tractor. The tractor, or self-propelled base for the processing machine also may be replaced by a trailer or a skid type of support. A fixed base even may be utilized where mobility is unnecessary. In the event of a skid-type support or trailer support, the apparatus or machine may be towed or otherwise propelled by a separate tractor unit. The endless track tractor, however, is preferred

as it is most suitable for mobility in the type of terrain where the processing machine is generally used because of such vehicles ground pressure advantage.

FRAME 200

The frame **200** consists of a base **201**, pivotally mounted upon the platform **109** of the tractor unit by the combined ring gear and monorace previously described and an upwardly directed rear frame **276**.

A hydraulic motor M5, driving a pinion **206**, is carried by the frame **200** and is mounted such that the pinion meshes with the ring gear **110**. The motor, is provided with suitable controls whereby the frame **200** is selectively rotatable about a vertical axis. The frame **200** includes a horizontal rearwardly extending portion **207** and a laterally extending portion **208**. The extending portion **208** (see FIG. **4**) provides a platform supporting a power source **209** and an operator's cab **210**.

The power source may be a diesel engine, a gasoline engine or the like and in the event hydraulic motors are used to drive the tractor and drive the processing units to be described hereinafter, a plurality of hydraulic pumps are driven by the power source through a gear reduction box or other suitable drive coupling. Two hydraulic pumps P1 and P2 are shown secured to a transmission **213** driven by the motor **209**. More pumps may be used as required to provide suitable fluid pressure to the various components. Electrical generators would be substituted for the hydraulic pumps in the event electrical motors are used.

Controls for the motors are located on a control panel CP on the platform forwardly of the motor. These controls however may be located at any place, on the machine, convenient to the operator.

The frame **200** further includes a pair of laterally spaced generally upright A frames **215**, each of which is notched at the upper edge thereof as at **216** for, as will be seen hereinafter, pivotally supporting the subframe assembly **300**. A hanger **219**, having a pair of outwardly directed lugs **216A** disposed in the A-frame notch **216**, is supported by each of the A-frames. The pin or lugs **216A** provides pivotal movement about a horizontal axis transverse of the machine. Each hanger is apertured so as to provide, in effect, a collar to receive a tubular beam of the subframe assembly **300** to be described in detail hereinafter.

The pair of A-frames **215** are disposed in spaced relationship transversely of the machine and secured thereto is a further transversely disposed A-frame consisting of a pair of legs **217** interconnected by a horizontal bar member **218**. The pair of A-frames **217** and the transversely disposed A-frame receive the subframe assembly therebetween as is seen from FIGS. **2**, **3** and **4**. As previously mentioned a tubular beam, to be described later with reference to the subframe assembly, is pivotally mounted by a pin or lugs **216A** on each A-frame **215**. Pivotal movement of the beam may be limited by suitably located stop members, for example abutments engageable with the beams or processing units **215**. The stop members may have a rubber or other resilient pad to absorb initial shock loads. The rear stops are located such that the beam is substantially horizontal when in abutment therewith and the front stops are located such that the beam dips downwardly forwardly approximately 30° when in abutment therewith. It is conceivable that the stops or abutments both at the front and rear may be provided with adjustable mountings such that the limit of pivotal movement can be varied. The stops may, for example, be supported upon hydraulic cylinders. The boom-and-grapple assembly **400** is pivotally mounted by a bearing **461** on the horizontal bar member **218** of the transverse A-frame. Reinforcing for the transverse A-frame, in the longitudinal direction, is provided by a pair of bars **272** secured at one end by a pin **273** to lugs **274** on the A-frame portion **218** and at the other end anchored to members secured to the frame **200**.

Projecting upwardly from the rearward portion **207** of the frame **200** is a framework **276**. The framework **276**, as will be seen hereinafter, provides means of supporting the speedup roll **1,100** and also in some embodiments facilitates securing the log-handling unit to the machine. The framework **276** includes a pair of uprights **280** interconnected at their uppermost end by a crossmember **281**. Further bracing is provided by a pair of rods **277** and **278** anchored at one end to the framework **276** and at the other end to the platform **200**.

BOOM-AND-GRAPPLE ASSEMBLY 400

The boom and grapple assembly **400** consists of an extendable and retractable boom pivotally mounted by a journal **461** on the member **218** and a grapple **460** secured to the free end of the boom. The boom **410** consists of three box members **401**, **402** and **403**. Each section **402** and **403** is movable and guided by a pair of rollers **406** secured one to each side of the members **401** and **402**. The rollers are each mounted by a pin secured to the sidewall of the box section. The roller projects through the sidewall of the member to which it is attached and engages the sidewall of the adjacent telescopic member. Each of the members **401** and **402** has a horizontally disposed roller secured to the leading edge thereof to engage the adjacent movable member. A pair of rollers (not shown) are secured respectively to the upper and lower trailing ends of the movable members **402** and **403**. These rollers engage respectively the upper and lower inner surface of the adjacent boom member. The movable sections are, by the foregoing rollers, fully guided and supported during extension and retraction of the boom. Additional guides or alternative arrangements may be used.

Each box member **401** and **402** has a pulley **405** pivotally mounted adjacent its forward end. A lug is secured to the trailing end of each of members **402** and **403**. These pulleys and lugs are used in conjunction with cables of a winch assembly **414** to effect extension and retraction of the boom section. The winch assembly **414** is secured to the outermost box section **401** adjacent the rearward end thereof.

A cable **427** has one end thereof wound on a drum of the winch assembly and the other end is attached to the lug of the boom section **402** at the trailing end thereof. The cable **427** passes over the pulley **405** secured to the boom section **401**. A second cable **426** is anchored at one end to the boom member **401** and at the other end to the lug at the trailing end of the boom member **403**. The cable **426** is threaded over the pulley **405** on the boom member **402** and thereby extends the boom member **403** simultaneously with extension of the boom member **402** from the fixed boom section **401**. A third cable **425** is anchored at one end to the trailing end of the boom member **403** and the other end is wound on a second drum on the winch assembly **1431**.

Referring now specifically to FIGS. **5** and **6**, the winch assembly **1444** consists of a pair of drums **1430** and **1431** of different but related diameters. The drum **1431** is mounted by a shaft **1432** between a pair of sidewalls of casing and the shaft is mounted in a pair of journals **1433** and **1434**. The shaft projects from the journal **1434** toward the opposite casing wall and secured to such projecting portion is a coupling **1445**. A stub shaft **1432A** is secured to the coupling **1445** and such shaft is attached by a rotary hydraulic coupling **1435**, to a hydraulic line **1436**. The hydraulic line **1436** is connected by the rotary coupling to a fluid supply line **1439** wound on the winch drum band **1438**.

The drum **1430** is mounted on a shaft **1440** journaled to the sidewalls of the casing by bearings **1441** and **1442**. A pair of sprockets **1443** and **1444** mounted respectively on shafts **1432** and **1440** by hubs **1445** and **1446** are connected in drive and driven relation by a chain **1444A**. The shaft **1432** is driven by a hydraulic motor M8 through a gear or drive member **1447** of a transmission assembly not shown. The cable **425** is wound upon the drum **1431** for retracting the movable sections by winding the cable onto the drum.

The outermost box member **401**, is pivotally mounted on the transverse A-frame to pivot about a horizontal axis transverse of the machine and such axis is disposed vertically above the longitudinal axis of the processing units. Other arrangements however may be used.

As previously mentioned, the boom and grapple assembly **400** is pivotally mounted by the trunnion **461** on the A-frame **217**. Control of the pivotal movement is effected by a pair of hydraulic cylinders **450** connected respectively at opposed ends to the boom **410** and the frame **276**.

Grapple **460**, suspended from the free end of the member **403**, consists of a fixed jaw **461** and a movable jaw **462**. The fixed jaw **461** includes a hollow casing terminating in a lower hooked end portion. The movable jaw **462** is mounted on the hollow casing by a pivot pin **464**.

A hydraulic cylinder **466** is disposed within the housing and anchored at one end by a pivot pin and lug to the movable jaw. The hydraulic cylinder is a double-acting type connected at one end to the hydraulic supply hose **1436** and the other end of the cylinder is connected by a hose **468** to an accumulator A2. The accumulator A2 may be disposed within the last or innermost section of the boom adjacent the free end or alternatively in the hollow jaw **461** as indicated in phantom. The accumulator provides positive pressure for the upper end of the hydraulic cylinder **466** normally biasing the jaws to a closed position. The accumulator A2 may be of any common well-known type, for example, one having a free movable piston separating a cylinder into a pair of chambers, one being in communication with the hydraulic supply fluid and the other chamber filled with a compressible fluid such as air. Biasing the jaws to a closed position is a safety feature whereby the log will not be dropped or released by the jaws in the event of a failure in the overall hydraulic system for the vehicle.

SUBFRAME ASSEMBLY 300

The subframe assembly **300** (see FIG. 7), as previously mentioned, is mounted on the frame **200** to pivot about a substantially horizontal axis transverse of the machine. The subframe assembly **300** consists of a pair of spaced, substantially parallel, tubular beams **301** interconnected and secured rigidly together by a plurality of processing units detachably secured thereto. The processing units, which will be described in detail hereinafter, include a delimber **600**, a debarker **700** and a slasher or shear **900**. These processing units may be used in various combinations or subcombinations depending upon the desired tree-processing operation. A pair of feed rolls **800** are also secured to the beams and the beam **301** is supported substantially intermediate its ends by a hanger assembly **219**. Each hanger, as previously mentioned, includes an aperture providing a collar **220** for receiving the beam. The collar permits the beams to be slid therealong such that the hanger can be positioned to balance the subframe assembly and thus retain the processing units in a normal desired rest position with respect to the horizontal, the purpose of which will become more apparent hereinafter.

Each processing unit, except the shear unit, is readily detachably secured to the beams by collars either having removable cap portions partially embracing the beam or entirely embracing the beam and slidable off the end thereon. Respective ones of a pair of collars on the processing units is located at opposite edges of the processing unit. An important feature is that the processing units are individually mounted and are removable. This facilitates removal of the unit requiring repair and a further workable unit may be substituted therefor cutting down lost time in field operation. The detachable independent securement of each unit facilitates substitution of one unit for another and removal of units to provide various combinations and subcombinations of processing units that may be desired. The first processing unit, i.e., the delimber **600**, is secured in such a manner that one side may be detached from one beam and pivoted about the coupling thereof to the other beam and thereby provide ready access to the next processing unit.

DELIMBER UNIT 600

The delimber includes a stationary housing **665** and a rotary housing **666** referred to hereinafter respectively as the stator and rotor. The stator is secured to the beams by a pair of lugs **667** which project outwardly from the stator casing and are notched to receive a portion of respective ones of the beams and a cap or collar **668** is pivotally secured thereto by a pair of studs **610**. The stator is generally L shaped in cross section having a generally flat planar end wall **669** and an outer generally circular wall **670** normal thereto. The planar wall includes a central aperture inscribed by a ring **671**. As will be seen hereinafter, such ring retains the stator and rotor in an assembled position. The wall **670** of the stator includes an enlarged portion **672** having a pair of sidewalls with aligned apertures for supporting a drive unit or coupling **675**. The drive unit includes a housing **676** detachably secured to one wall and a shaft **677** projecting therefrom and journaled in the other wall by a bearing **674**. The shaft is journaled in the housing **676** by a bearing **678** and keyed to the shaft **677**, intermediate the journals or bearings, is a gear **679**. The drive unit includes a clutch or flexible coupling assembly **680** whereby a hydraulic motor M2 is detachably secured in a driving relationship with respect to the gear. An internal ring gear **682**, having teeth **682A**, is detachably secured to the stator wall **669** on the inside thereof by a plurality of studs or the like.

The rotor **66** consists of a generally annular plate **683** having a combined guide and fastening ring **684** adjacent the outer perimeter thereof and an annular collar or sleeve **685** journaled on the internal periphery by a thrust bearing **686**. The thrust bearing **686** is adjustable by means of a threaded annular gland nut **687** and consists of a plurality of balls in **686A** clampingly engaged between the gland nut and a flange **688** on the annular plate and a groove **689** in the outer periphery of the sleeve **685**. The gland nut and flange provide a split race for adjustment. The other portion of the race is formed by the groove **689** in the outer periphery of the annular flange. The sleeve **685** includes a series of appertures **690** in one edge thereof whereby the ring **671** of stator may be secured thereto by a plurality of studs **691**. The opposite end of the sleeve **685** includes a groove in the outer periphery thereof for receiving a sealing ring **692**. The combined guide and fastening ring **684**, at the outer periphery of the annular rotor plate, consists of a body portion having a flange **693** projecting therefrom and apertured for detachable securement to the stator adjacent the outer periphery thereof by a plurality of studs. The ring and guide plate include an inner generally flat surface adapted to bear against a sealing ring **695** retained in a groove **696** in the outer periphery of the main portion of the rotor. The rotor plate **683** has an external ring gear **697** detachably secured thereto by a plurality of studs **697A**. The ring gear **697** meshes with the gear **679** of the drive assembly whereby the rotor is driven by a motor M2.

The rotor plate **683** has three apertures **698** therethrough spaced from one another at 120° about the axis x—x of the delimber. A housing portion **699** of respective ones of three delimber arms **610** are journaled in the apertures by a collar **1600**. The housing **699** is journaled within the collar **1600** by a pair of bearings **1601** and **1602**. The housing extends outwardly from the bearing **1602** and terminates in an enlarged gear casing **1603**. A shaft **1604** is journaled in the housing by a pair of bearings **1605** and **1606** and keyed to one end of the shaft is a gear **1607**. The gear **1607** meshes with the internal ring gear **682** mounted on the stator. A bevel gear **1608** is keyed to the opposite end of the shaft and is enclosed in the enlarged gear casing portion **1603** of the housing. A cap or cover plate **1609** is secured to the outer end of the gear casing portion by means of a plurality of studs whereby access is provided to the interior. The gear portion of the housing includes an aperture **1610** at one edge thereof for detachably securing thereto an arm **1611**. Journaled within the arm **1611** by bearings **1613** and **1614** is a shaft **1612** having bevel gears **1615** and **1616** keyed respectively to opposed ends thereof. The bevel gear **1615** meshes with the bevel gear **1608** whereby

the shaft **1604** drives the shaft **1612**. The arm **1611** includes a pair of spaced apertures with the axis thereof normal to the axis of the shaft **1612**. A shaft **1620** is journaled in these apertures and one end projects therefrom for detachably securing thereto a cutterhead **1621**. The shaft is tapered for receiving a correspondingly shaped aperture in the hub portion **1622** of the cutter head and the latter is retained on the shaft by a locknut **1623**. The bearings are retained in position by respective end caps **1624** and **1625** each detachably mounted by a plurality of studs or the like. A beveled gear **1626** is rigidly secured to the shaft **1620** and meshes with the bevel gear **1616**. It is thus readily apparent that the cutterhead is driven through the gear train **682, 1607, 1608, 1615, 1616** and **1626**.

The housing **699** and the attached arm **1611** may be filled with a suitable lubricant. A plurality of seals **1681, 1682, 1683** are provided to retain the lubricant within the casing.

It will be apparent that the arms rotate with the rotor and in addition while they are rotating, the heads themselves are driven to rotate. The position of the arms with respect to a log passing therethrough may be varied controllably by hydraulic cylinders **1640** anchored at one end to the rotor and at the other end to the housing **666** by a clamp. Each arm is individually controlled by respective ones of the hydraulic cylinders **1640** and the arms, if desired, may be interconnected by synchronizing links **1646** pivotally secured at opposite ends to lugs projecting outwardly from the gear casing **1603**.

Since the arms are hydraulically controlled, they may be pivoted outwardly and inwardly in response to control of fluid pressure. The free end of arms serve as work-engaging stops by engaging a tree being processed and thereby prevent the cutterhead from digging into and damaging the tree being processed.

In operation, the rotatable housing is driven by the hydraulic motor M2 through the coupling **680** and the spur gear **679** meshing with the external ring gear **697**. Rotation of the rotatable housing is approximately 130 r.p.m. and during such rotation, the gear **1607** meshes with the internal ring gear **682** fixed to the stator thereby causing the cutterheads to rotate. The heads rotate at approximately 3,000 to 4,000 r.p.m. The speeds given herein are merely by way of example since they have been found to produce satisfactory results in an actual machine. In delimbing a tree, the trunk passes through a central aperture in the delimber defined by the collar **671** and the sleeve **685**. The tree moves longitudinally through the delimber and this causes the rotating heads to travel around the tree in a spiral path. The rotating heads having sharp cutting edges which remove the limbs from the tree.

The cutterheads **1621** each consist of a hub **1622** having a plurality of blades generally parallel to one another and to the axis of rotation of the cutter head. The blades are of substantially constant outer diameter, throughout their length and slope in the direction of rotation. Each blade extends inwardly at the forward end **1671** of the cutter head toward the hub **1622** to provide a forward cutter edge. The blades are relatively shallow with respect to the overall diameter of the hub and, as mentioned, they slope in a direction of travel to present a relatively sharp leading or cutting edge. The blades may be integrally formed with the hub or alternatively be detachably secured thereto in any well-known manner as known, for example, from the general art of milling and planing. Cutterheads of this configuration have been found to operate satisfactorily driven at a speed of approximately 2,000 r.p.m. while blades tapering from the leading edge of the trailing edge of the cutterhead have been found to give satisfactory results when operating at a speed of roughly 4,000 r.p.m. The cutter speed however may be varied by variously selecting the gears of the drive. In the arrangement shown, the cutter speed is related to the rotor speed.

DEBARKER 700

The debarker is detachably secured to the beams **301** in trailing relation with respect to the delimber **600**.

A debarker of the type illustrated in U.S. Pat. No. 2,857,945 which issued Oct. 28, 1958 to P. G. Brundell et al. may be used and which includes two sets of feed rolls mounted directly thereon. It has been found preferable, however, to separate the feed rolls and the debarker so that they are each independently mounted on the beams **301**. The separate feed roll mechanism not associated with the debarker will be described hereinafter. In utilizing the combined debarker and feed roll mechanism as disclosed in the above patent, it has been found desirable to provide separate power sources for the debarker and the feed rolls. Thus, a motor, such as hydraulic motor M6 may be used to drive the feed rolls **800**, and a motor, such as hydraulic motor M1 used to drive the debarker. These motors may be connected in driving relationship by pulley and V-belt assemblies or gear drives any of which can be conveniently constructed and arranged.

The debarker **700** includes a stationary housing **705** fixed to respective ones of the beams **301** by a pair of collars **701**. The collars are provided by a pair of lugs or ears **721** secured to the stationary housing and projecting outwardly therefrom on opposite sides thereof. Each lug **721** terminates in a half-collar portion **722** open downwardly and adapted to cooperate with a cap **723** detachably secured thereto to embrace the beam **301**. The debarker also includes a rotatable housing **706**, carrying a plurality of arcuate arms **707**. The rotatable housing is driven by the motor M1 in driving connection with the housing through, as mentioned, a pulley and V-belt assembly or suitable gear train. The debarker stationary housing **720** includes an enlarged motor and gear housing **724**. The hydraulic motor M1 is secured to the housing and access to the drive may be attained by removing a pair of cover plates **725**.

FEED ROLLS ASSEMBLY 800

In processing trees, the boom and grapple lifts the tree and feeds it directly to the first unit in the subframe assembly. The tree as it passes through is then picked up and continued to be fed through the processing units by the feed rollers **800**. One or two sets of feed rollers may be used as previously described. Utilizing the feed rollers, the boom and grapple is free to select the second tree and bring it to the processing units to be processed as soon as the first tree is completed or has passed through the first of the processing units.

In the aforementioned U.S. Pat. No. 2,857,945, the debarker stationary frame and feed roll frame are common. In order to provide a relatively versatile processing assembly, it is preferable that the feed roll sets be mounted on their own frame independent of the other processing units. Not only does this facilitate servicing and installation of the feed rollers, but also it permits adjustment of the relative position of the feed rollers with respect to the remainder of the processing units. Shown in FIGS. **12** and **13**, the feed roll assembly **800** consists of a frame **801** having arms **802** projecting outwardly from opposed edges. These arms each include a collar having a bearing surface **803** for resting upon the upper end of respective ones of the tubular beams and a cap **804** is detachably secured to the respective arms clampingly to engage the beam **301**. Bolt-and-nut assemblies **805** are used to tighten the cap onto the extending leg and the feed roll assembly is thereby securely fastened to the beam **301**.

The mounting arms on the various processing units are a rather important feature since such mounting provides detachable securement of the processing units to the beams. The collar for mounting the feed roll is split along a horizontal diameter as may also be the case with the debarker. Three arms **806** are secured to the frame and are pivotable about an axis parallel to the beams **301**. The arms are directed towards one another and each arm has a roller **807** pivotally mounted on the free end thereof. EAch of the rollers has an arcuate surface **808** having a plurality of spikes **809** projecting therefrom for grippingly engaging the tree surface. As seen in FIG. **13**, the arcuate shape of the roller surface permits relatively small trees to be clampingly engaged therebetween and the mount-

ing of each arm is such that as the arm pivots outwardly, the spiked roller thereon does not abut any of the remaining spiked rollers. The arms are biased inwardly to retain the rollers in contact with the tree and the rollers are driven by the motor M6 mounted upon the frame. As seen in FIGS. 2, 3 and 7, when a pair of roll assemblies **800** are utilized, a propeller shaft **325** interconnects the two assemblies and thus, only one motor is required to drive the two sets of rollers. This also insures that the two sets of rollers are driven at the same speed. The arms **806** are interconnected by a pair of bars **812** and **813** so that movement of one arm effects movement of the others inwardly and outwardly toward and away from a tree being fed.

The feed rollers are biased inwardly towards the center axis of the feed roll unit, i.e., towards one another by a rubber spring **814**. The resilient force of the spring is distributed to each of the arms through the synchronizing or interconnecting links **812** and **813**. In addition to a rubber spring, the spring assembly also may include a hydraulic dappling means, a rubber cushion, means for regulating the spring force and means for stopping the motion of the feed rolls towards the center of the frame. The stop of the feed rolls towards the axis may be determined by the desired minimum long diameter. The spring assembly is readily detachable so that the arms can be readily swung outwardly for servicing or gaining access to the interior of the frame **801**.

Three electrical switches SW2, SW3 and SW7 are mounted on the frame **801** of the feed roll assembly and are actuated by movement of the synchronizing link **813**. Each of the switches is secured to the frame **801** as by a plurality of bolts or studs and the switch-actuating arm extending therefrom has a cam follower **815** rotatably mounted adjacent the outer end thereof. The cam follower **815** of respective switches SW2, SW3 and SW7 engages respective striker plates **816**, **817** and **818** mounted on the synchronizing link **813**. Each striker plate **816–818** may consist of a generally L-shaped bracket having an elongated slot in one leg thereof whereby such leg may be secured to the synchronizing link by a stud, the elongated slot providing adjustment such that the relative position of the striker portion may be adjusted with respect to the cam follower. The striker plates **816**, **817** and **818** are distributed longitudinally along the synchronizing link intermediate the latter's opposed end pivotally secured to the L-shaped arms **806**. The switches SW2, SW3 and SW7 sense respectively three diameters so that they are actuated by trees of 3-inch diameter, 1½-inch diameter and 6-inch diameter. Actuation of the switches can be accomplished by selecting proper location for the switches along the length of the synchronizing link. This is so due to the fact the synchronizing link is carried by lugs projecting outwardly from the arms carrying the feed rollers.

SHEAR OR KNIFE UNIT 900

A shear or slasher unit is mounted on the beams **301** in axial alignment with the other processing units. The shear unit is at the trailing end of the other processing units with respect to the direction of travel of a tree being processed as it passed therethrough and it is mounted by members telescoping into the beams.

Referring now to FIGS. **14** and **16** inclusive, the slasher or shear unit **900** is positioned at the rear of the machine and is mounted for limited horizontal movement away from and toward the debarker **700** and the second set of feed rolls **800**. The horizontal sliding movement permits severing the delimbed and debarked tree by the shear unit while the tree continues to move through the machine. The shear unit may be driven at a speed in timed relation with respect to the tree being processed so that they travel at the same speed during the severing operation. Alternatively, the shear unit may be carried along by the trunk of the moving tree due to engagement of the shear blades, or some other abutting surface, with the tree.

The cutoff knife or shear unit consists of a housing **901** secured by a pair of lugs **902**, (one on each of opposite edges of the housing) to respective ones of a pair of beam members **903**. The beam members **903** extend forwardly parallel to and in telescopic relationship with respect to the beams **301**. The beam members **903** and the mounting thereof will be discussed in more detail hereinafter.

The housing **901** consists of a pair of frame members **941** and **942** detachably secured together by a plurality of studs **943**. The frame **941** is essentially a flat plate which includes a central aperture **945**. The frame member **942** consists of a flat rear plate (also having a central aperture and pair of sidewalls. The plates and sidewalls provide a cavity and guide slidably to receive a pair of movable cutting members.

The arms **902** are secured to respective ones of the sidewalls terminating at the free end in a split collar **948**. A pair of studs or bolt-and-nut assemblies may be used to tighten the collars onto the tubular members **903**. The front and rear faceplates and the sidewalls together form a pair of channels which may be lined with wear plates **951**. Respective upper and lower knife-mounting yokes **954** and **955** are slidably mounted and guided for vertical movement in these channels. A pair of ears or lugs **956** are secured to each of the yokes and these ears slidably engage the wear plates. A hydraulic cylinder **958** is pivotally mounted on the housing at each end of the guide channel by a pivot pin **961** and the movable piston rod **959** is pivotally connected to the lug **956**. As will be seen from FIG. **14** there are four hydraulic cylinders **958**.

A shear blade **964** is secured to each one of the yokes **954** and **955** by a plurality of bolt-and-nut assemblies **965**. The yokes may be provided with a recess to receive an outer peripheral edge portion of the blade **964** and thereby provide symmetrical support for the same. The bolt-and-nut assembly alternatively may include an arcuate plate **968** clampingly urging a peripheral portion of the knife against a flange on the yoke. The upper yoke has a bore **969** extending therethrough adjacent each corner and terminates at the lower edge thereof. A plunger **970** extends through the bore and is biased downwardly by a compression spring. A pair of microswitches SW5 and SW6 are detachably secured to the yoke and the actuator thereof is adapted to be engaged by the plunger **970** in respective ones of the bores **969**. The plunger projects below the yoke so as to be engaged, upon closing of the shears, by the lower yoke. As will be seen hereinafter the microswitches effect reversal of the yokes to open the shear after reaching a closed position during cutting a tree.

The shear **900**, illustrated, is mounted so as to move along with the log during a severing or cutting operation. The shear is a guillotine type and may be referred to as a flying shear because of the particular mounting. Referring to FIG. **15**, the collars **948** are secured to respective ones of the pair of tubular members **903** disposed in sliding telescopic arrangement within the beams **301**. The beam **301** at the rear end has an outwardly directed flange **974** rigidly secured thereto. A cap member **975** is detachably secured to the flange by a plurality of studs **976** and the tubular member **903** passes through an aperture **977** in the cap. A seal member **978** is secured to the cap and slidingly engages the outer surface of the tubular member. A rubber bellows-type collar **979** is anchored at one end to the cap **975** and at the other end to a collar **980** fixed to the tubular member **903**.

Three roller assemblies **981**, each consisting of two rollers **982** mounted on spaced, generally parallel shafts **983**, are secured to the tubular member **301** adjacent the cap end. The rollers are mounted upon a ringlike sleeve **984** which fits into an enlarged area adjacent the rear end of the beam and retained in position by the cap member. The rollers project inwardly of the sleeve and rollingly engage the outer peripheral surface of the tubular member **903**. The member **903** carries at its leading end three roller assemblies **985**, each consisting of a pair of rollers **986** secured by shafts **987** to lugs **988** on an annular sleeve **989**. The annular sleeve is secured to the leading end of the tubular member **903** and retained in position by

a C-ring **990**. The roller assemblies at the leading end of member **903** rollingly engage the inner peripheral surface of the tubular member **301**. The roller assemblies at the leading end of the member **903** and the roller assemblies at the capped end of member **301** provide spaced guide rollers for the telescopic movement of each member **9** inwardly and outwardly with respect to the tubular beam **301**.

The tubular member **903** is biased to a retracted position by a compression coil spring **991** which is anchored at one end to the tubular member **903** by a collar **992** and at the other end to a flange **325** on the tubular beam **301**. The latter anchor is provided by a bolt **993** having a collar **994** retained thereon by a nut **995**.

The shear is carried on the end of the tubular member **903** projecting outwardly of beam **301**, the telescopic mounting permitting the shear to move as a unit horizontally to the right as FIGS. **2** and **3**. It is normally at a rest position and biased to the position as shown in FIG. **2** by the previously described coil spring.

The switches SW5 and SW6, illustrated in FIG. **14** mounted on the yoke **954**, may be replaced by a single switch mounted on the housing. A switch SW5 (not shown) may be secured to the back of the housing member by brackets with the actuating lever arm thereof projecting inwardly into the knife housing cavity to engage a striker plate adjustably secured to the yoke. Adjustments of the striker provides means of adjusting the relative position of the cutter knives in such an arrangement at a shear closed position.

A further electrical switch SW9 is mounted upon the frame and includes a lever-actuating arm adapted to abut the yoke **954** when the latter is in a shear fully open position. A further switch SW8, having an actuating lever arm is mounted on the shear frame such that the lever arm is adapted to abut the yoke **955** when the shears are in a partially open position. The switches SW8 and SW9 respectively are actuated by the yokes **954** and **955**; however, this need not be so as both switches could be actuated by the same yoke. EAch of the switches SW8 and SW9 are mounted on the shear frame by brackets or the like which may be provided with slotted apertures whereby the switches are adjustable. The adjustable mount permits or allows for lag in effecting operations controlled by the switches.

LOG-MEASURING APPARATUS AND SHEAR CONTROL 1000

In the embodiment of the machine illustrated in FIGS. **2**, **3** and **17–19**, there is a log-measuring device generally indicated as **1000** consisting of a frame **1001** projecting rearwardly from the end frame **276**. Depending downwardly from the frame **1001** and pivotally secured thereto, is a striker **1002** adapted to be engaged by the log as it emerges from the processing units. Pivotal movement of the striker plate actuates a switch SW4 (illustrated in the electrical circuitry only) to effect or initiate operation of the shears to cut the processed tree bolt into a selected length.

The frame **1001** (see FIGS. **18** and **19**) consists of a pair of arms **1004** cantilevered rearwardly from the frame **176**. The flapper or striker plate **1002** is pivotally mounted by a shaft **1005** mounted at opposed ends in respective ones of a pair of journals **1006**. The journals may be secured to respective ones of the pair of arms **1004**, for example, as by a pair of studs **1007** longitudinally slidable in a slot **1008** in the respective arms. Movement of the striker, forewardly and rearwardly with respect to the machine, permits varying within limits the length of the severed logs.

CLEARING OR SPEEDUP ROLL 1100

A clearing roll **1100** is mounted upon the frame **276**. The clearing roll is located somewhat below the axis of the feed path followed by a tree being processed as it passes through the processing units. The clearing roll consists of a hub **1101** mounted upon a shaft **1102** journaled by a pair of bearings **1104** secured to the frame **276**. A series of serrated discs **1107** project outwardly from the hub and are disposed in horizontal spaced relationship. The serrations of adjacent discs are offset to provide maximum gripping force with the surface of the processed tree. The speedup or clearing roll is driven substantially at the same speed as the feed rolls by a hydraulic motor M7 and assists in delivering the processed cut log from the processing units to the off-feed conveyor or log-handling unit.

The motor M7 drives the clearing roll **1100** through a chain **1108** and sprockets **1109** and **1110** secured respectively to the motor and the roll shaft **1102**.

In FIG. **21** there is illustrated a further clearing roll **11000''** having a spiked peripheral surface for engaging a processed log discharged from the processing units. The clearing roll **1100''** may be freely rotatable on a mounting shaft **1121** or alternatively driven by suitable means such as, for example, motor M7.

LOG-HANDLING UNIT 500

The log-handling unit **500** is secured to the processing machine at the trailing end thereof to receive the processed tree bolts. The log-handling unit illustrated in FIGS. **17** and **18** consists of a conveyor portion **560** pivotally attached to a platform **510** projecting rearwardly from the vehicle and a hopper or guide portion **530** located above the platform. The entire assembly i.e., the conveyor, platform and guide is secured to the end frame **276** of the vehicle in any convenient manner so as to move in unison with the vehicle platform **200**. Modifications relating to mounting the log-handling unit as well as modifications to the construction of the log-handling unit will be discussed hereinafter.

The platform **510** consists of a pair of channel members **511** interconnected by suitable cross bracing (not shown) and a cover or top plate **512**. Secured to and projecting outwardly from the platform is a guide plate **513** having a pair of elongated slots **514** and **515** to receive cleats on the conveyor as will become apparent hereinafter. The platform is rigidly secured to the frame **176** by welding, bolting or the like and reinforcement is provided by gusset plates **516** and a crossbar **516A**.

Secured to the platform is a pair of bracket members **517** and **518** having respective apertured lug portions **519** and **520** for use in pivotally attaching the conveyor to the platform. Also secured to the platform is a further pair of apertured lugs **521**, which as will be seen hereinafter, pivotally connects a hydraulic cylinder to the platform. Mounted on the upper surface of the platform is an off-feed roller **1100** which may be freely rotatable or driven. This off-feed roller may also be referred to as a speedup roll and may be used in place of or in addition to the roll **1100**.

The guide portion **530** of the log-handling unit is located vertically above the platform **510** and consists of a hopper, having a pair of opposed sidewalls **531** and **532**, attached at one end to the frame **276** and interconnected at the opposite end by an end wall **533**, a front deflector bar **534** and; a rear deflector wall **535**. Each sidewall **531** and **532** includes a sloped upper portion attached at the upper edge to respective ones of a pair of bar members **536** and **537** and a substantially vertical portion. The vertical portion of the walls is located one on each side of the platform **510** adjacent the longitudinal marginal edges thereof. The vertical portion of the side walls **531** and **532** are secured respectively to upright channel members **538** and **539** which together with a platelike member provides the rear wall **533**. The rear deflector wall **535** consists of a first portion **535A** extending angularly from the vertical portion of wall **532** to the vertical portion of wall **531** and a second portion **535B** projecting outwardly from the latter vertical wall portion. The front deflector bar **534** is attached at one end to the vertical portion of the wall **532** and slopes downwardly in a direction toward the other wall and is secured at the other end to the platform. The bar **534**, as will be noted from FIG. **17**, is located at a position adjacent but rearwardly of the off-feed roller **1100'**.

The vertical portion of the sidewall **532** may be secured to the platform, however the corresponding vertical portion of the sidewall **531** terminates vertically above the platform to provide a discharge opening **540**. Such discharge opening may be of any convenient size for example it may be substantially the entire vertical portion of the sidewall **531** as shown in FIG. **19**.

Processed logs are discharged from the last processing unit into the guide portion **530** of the log-handling unit. If the log is discharged at an angle to the part normally followed while being processed, the sloped sidewalls **531** and **532** reorient the log so as to be substantially parallel to the path and the platform **510**. The leading end of the processed log strikes the angled end wall portion **535A** and is deflected laterally toward the conveyor. The opposite end of the log strikes the sloped guide bar **534** and the log is thereby shifted laterally toward the conveyor simultaneously with being discharged from the processing unit. As will be seen hereinafter such discharge from the last processing unit is facilitated by the driven off-feed or speedup roller **1100'** and/or **1100'**.

The conveyor **560** includes a frame assembly which is pivotally secured to the apertured lugs **519** and **520** by a shaft **561**. The frame includes a pair of side frame members **562** and **563** interconnected adjacent opposed ends respectively by end frame members **564** and **565**. The side members are braced by crossmembers **566**. Secured rigidly to the frame members and projecting beyond the end member **564** is a pair of journals **567** and **568** rigidly interconnected by a sleeve **569**. The sleeve circumscribes the shaft **561** and secured to such sleeve is an apertured lug **570** projecting outwardly and downwardly in a direction toward the lug **521** as illustrated in FIG. **18**. The frame side members **562** and **563** have respective apertured end portions **570** and **571** projecting beyond the end member **565**. A shaft **572** is mounted on the end portions **570** and **571** and mounted on such shaft is a pair of sprockets **573** and **574**. The shaft may be journaled in the end portions **570** and **571** or alternatively the sprockets may be journaled on the shaft in which event the latter may be fixed to the frame. A pair of sprockets **575** and **576** are secured to the shaft **561**. The sprockets **575** and **573** are in alignment at a position outwardly of the conveyor frame adjacent the side member **562**. Similarily the sprockets **574** and **576** are in alignment at a position outwardly of the opposite side of the conveyor frame adjacent the side member **563**.

Endless chains **577** and **578** entrain respective pairs of sprockets **573, 575** and **574, 576**. Each chain has a plurality of lugs **579** secured thereto in spaced relationship longitudinally therealong and projecting outwardly therefrom. The lugs on chain **577** are substantially in alignment with the lugs on chain **578** in a direction parallel to the length of the platform **510**.

The shaft **561** projects beyond the sprocket **576** and secured to such projecting portion is a V-belt pulley **580**. A hydraulic or electric motor **M25**, having a V-belt pulley **581** secured to the shaft thereof, drives the shaft **561** by a V-belt **582**. Obviously the V-belt and pulleys may be replaced by a chain and pair of sprockets, a gear or fluid transmission or the like. The motor **M25** is secured to the platform **510** and located at a position below the upper plate **512**. The exact position is immaterial and for sake of convenience of illustration it is omitted from FIG. **18**. The chains of the conveyor are driven in timed relation, by the motor, in a counterclockwise direction as viewed in FIG. **18** to deliver the processed logs from the platform **510** to a position on the ground laterally offset therefrom.

The free end of the conveyor can be raised and lowered selectively by controlling fluid to a hydraulic cylinder **590** pivotally connected at one end by a pin **591** to the lugs **521** and at the other end by a pin **592** to the lugs **570**. The free end of the conveyor accordingly may be raised and lowered depending upon the vertical position of the pile of processed trees previously deposited on the ground or other log support such that the logs have a relatively small drop from the conveyor onto the pile. This facilitates piling the logs neatly and in relatively high piles. It also enables delivering the processed logs directly from the processing machine onto a log carrier located adjacent thereto.

A pair of guardplates **593** may be secured to the conveyor adjacent the free end thereof to protect the return portions of the chains from the piled logs and vice versa. A sensing switch may be attached to one or both of the guardplates **593** to sense the pile height and actuate means to adjust the height of the free end of the conveyor relative thereto.

In operation, processed logs are driven by the speeding-up roll **1100** and are guided by the side and end walls onto the conveyor. The driven conveyor delivers the processed logs in sequence and discharges the same over the free end of the conveyor to a pile of processed logs previously delivered by such conveyor similarly to the same position and dropped onto a support below. The support may be the ground or alternatively a carriage trailed by the processor or other powered vehicle. The carriage may be adapted to receive the processed logs and if desired such carriage may be drawn or driven to deliver the logs to a mill or other location as desired.

A modified log-handling unit is illustrated in FIG. **20** wherein the conveyor consists of a first portion **560** pivotally attached to a second portion **560'** in end-to-end relation. The conveyor **560** is the same as the previously described conveyor except that the apertured lug **570** is secured to the conveyor frame at position between the shafts **561** and **572**. The conveyor portion **560'** may be the same as conveyor **560** differing in that it is rigidly mounted on the vehicle and in the spacing between the endless chains. In regard to the latter, it will be seen that the sprockets at the other end of the conveyor **560'** are mounted on a common shaft **561**. This serves as a common drive for the two conveyors and pivotally interconnects the conveyors. The chains on the conveyor portion **560'** are located either outwardly or inwardly of the corresponding chains on the conveyor portion **560**.

The conveyor portion **560'** is mounted on a pair of beam members **511'** rigidly secured to and projecting rearwardly from the vehicle frame **276**. The upper surface of the fixed conveyor portion **560'** is located at a position slightly below the upper surface of off-feed roller **1100** and includes a deck or plate portion **512'** for receiving the processed logs.

In each of the embodiments disclosed in FIGS. **17** to **19**, the log-handling unit is secured to the frame **200** of the vehicle. An alternative arrangement is illustrated in FIG. **21** where an off-feed conveyor **560'** is secured to a frame independent of the movement of the vehicle frame **200**.

Shown in FIG. **21**, the off-feed conveyor **560''**, consisting of endless chains **577** and **578** interconnected by a plurality of baffle members **579'**, is secured to a frame **200'**. The frame **200'** includes a first deck portion **201'** interposed between the vehicle under carriage **100** and the frame **200** and a second deck portion **202'** offset from and located vertically above and outwardly from the deck portion **201'**. An off-feed speedup roll **1100''** is located on the deck portion **202'** and the entire assembly is mounted in such a manner as to pivot about a vertical axis y—y independent of the slewing motion about the same axis of the frame **200** (and processing units mounted thereon).

The off-feed conveyor **560''** may be fixed in relation to the frame portion **202'** or alternatively pivotally attached thereto as is the conveyor **560** illustrated in FIG. **18**. Alternatively the conveyor **560''** may be of the type illustrated in FIG. **20** consisting of a portion fixed to the deck **202'** and a further portion pivotally attached thereto.

In the embodiments illustrated in FIG. **21**, the conveyor assembly may be pivoted about the axis y—y to receive a log, as it is discharged from the conveyor, and thereafter pivoted to a different position to deliver and discharge that processed log to a selected location relative to the machine. Alternatively the conveyor assembly may be used as an accumulator to receive and temporarily store a selected quantity of processed logs and thereafter discharge the logs in a selected location.

The conveyors in the foregoing embodiments may be operated continuously or intermittently as desired.

In the off-feed conveyor arrangements described in the foregoing, pivoting the conveyor assembly about the y—y axis causes the discharge end of the conveyor to move through an arc. During processing of trees taken from felled trees in a bunch, the machine may be slewed through an arc of 25° to 30° or more. This will, in the case of where the conveyor assembly is attached to the frame **200**, result in corresponding arcuate movement of the discharge end of the conveyor. In such instance, the logs discharged from the conveyor, when at the two extremes of the arcuate movement, will be angularly related with respect to one another and not in a common row as they will be laterally offset from one another i.e., offset in a direction parallel to the longitudinal axis of the logs). In FIGS. **21** and **22** there is diagrammatically illustrated an arrangement where logs are discharged from the conveyor substantially parallel to one another irrespective of limited arcuate movement of the processing machine.

Referring to FIG. **22**, a conveyor **560** is pivotally attached to a mounting lever arm LA pivotally secured to the platform **510** which is fixed to the rotary deck **200** (not shown but the same as previously described) mounted on an undercarriage or tractor unit **100**. The rotary deck pivots about a vertical axis VA_1 and the lever arm LA pivots about a vertical axis VA_2. The vertical axis VA_2 moves through an arc corresponding to the slewing movement of the rotary deck about the axis VA_1. A link member LM interconnects the lever arm LA and the under carriage **100** in such a manner that there is in effect a parallelogram. The link LM is pivotally attached at one end to the lever arm for pivotal movement about a vertical axis VA_3 and at the other end to the undercarriage for pivotal movement about a vertical axis VA_4. The pivot points VA_1, VA_2, VA_3 and VA_4 define the parallelogram. Arcuate movement of the conveyor assembly about pivot axis VA_1 causes the lever arm LA, through connecting link LM, to pivot in the opposite direction about the vertical axis VA_2. The latter pivotal movement, by proper selection of the relative positioning of the pivot points with respect to one another, permits discharging the processed logs parallel to one another irrespective of limited arcuate movement of the conveyor about the pivot axis VA_2. The arcuate movement for example may be 30° which causes a lateral shift in the discharge end of the conveyor. The amount of shift however is negligible considering the length (normally 8 feet) of the logs being discharged.

An arrangement for discharging the processed logs in substantially a common row, irrespective of limited arcuate movement of the processing units about a vertical axis, is diagrammatically illustrated in FIG. **23**. Shown therein is a conveyor **560A** secured to the deck or platform **510** rigidly attached to the frame **200** (not shown in FIG. **22**) pivotally mounted on an undercarriage or tractor unit **100**. The conveyor **560A** consists of side frame members **562A** and **563A** pivotally connected respectively at one end by pins BB and CC to an end member **565A** and at the opposite end respectively by pins DD and EE to an end member **569A**. The end member **569A** is attached to the platform **510** to pivot about a horizontal axis HA_1 and thereby permit raising and lowering of the free end of the conveyor **560A**.

The conveyor includes a pair of endless chains **577** and **578** entraining respectively sprockets **573**, **575** and **574**, **576**. The sprockets **573** and **574** are mounted on stub shafts secured respectively to the frame side members **562A** and **563A**. Sprockets **575** and **576** are secured respectively to shafts **575A** and **576A** journaled in respective ones of side frame members **562A** and **563A**. The shafts **575A** and **576A** are interconnected by a pair of universal joints UJ and a shaft **575B** driven by a motor through a suitable coupling.

The conveyor side frame member **562A** and the undercarriage **100** are interconnected by a link LM_1. The link LM_1 is pivotally connected by a pin FF to the member **562A** and at the other end by a pin GG to the undercarriage.

The conveyor assembly **560A** and the platform **510** pivot on the undercarriage about a vertical axis VA_1. The pivot pins DD, EE and the pivot axis VA_1 are located on a common line and the link LM_1 is substantially parallel thereto. In effect a first parallelogram is provided by the link LM_1, the undercarriage, the rotary deck and the conveyor and a second parallelogram is provided by the conveyor side frame and end frame members. Arcuate movement of the platform **510**, about the pivot axis VA_1, through the link LM_1, causes an inward and outward shifting of the free end of the conveyor toward and away from the undercarriage dependent upon the sense of rotation about the vertical axis. Such shifting permits discharging the logs in substantially a common row irrespective of limited arcuate movement of the processing unit, i.e., the rotary deck. Movement of the deck however causes movement of one endless chain relative to the other longitudinally therealong such that the logs will not necessarily remain parallel to one another as is the case with the embodiment illustrated in FIG. **22**.

It will be seen from the embodiments in FIGS. **22** and **23** the conveyor is constructed in one instance (FIG. **23**) in such a manner as to enable discharging the logs in substantially a common row (transverse to the length of the logs) irrespective of limited arcuated movement of the conveyor caused by slewing the vehicle during processing of the trees and mounted in another instance (FIG. **22**) such that the logs are discharged parallel to one another.

HYDRAULIC CONTROLS

The processing machine previously described is preferably hydraulically operated. The power unit **209**, mounted on the base of the frame, provides power for driving hydraulic pumps identified in FIG. **4** by the reference numerals **P1** and **P2**.

FIG. **24** is a schematic of the hydraulic system for the processing machine illustrated in the drawings. The hydraulic system consists generally of two hydraulic pumps identified respectively as **P1** and **P2** providing fluid pressure for the operation of hydraulic motors **M1** to **M8** inclusive and **M25**, through various control or selector valves. These pumps also supply pressure for hydraulic cylinders operating various parts of the machine.

Referring to FIG. **14**, the pump **P1** is a 10-piston pump having two pistons providing fluid pressure through a line **L1** to a selector valve **V1**. The selector valve controls the flow from line **L1** to one or the other of lines **L2** and **L3**. The line **L3** provides fluid for the delimber motor **M2** and the flow is controlled by a valve **V2**. The pump **P2** which is also a 10-piston hydraulic pump has four pistons supplying fluid to the tractor track motor **M4** through the control of valves **V2** and **V4**. These valves are connected by a line **L4** which is also connected with the line **L2**.

As will be seen hereinafter, the output from the pump **P2** through line **L5** may be added to the output from **P1** to provide a driving force for motor **M4**. The valve **V2** controls the flow of fluid to the delimber motor **M2** and located in such circuit is a relief valve **RV6**. A relief valve **RV8** is also interposed between the valve **V4** and the tractor motor **M4**. Fluid from six cylinders of the pump **P2** is controllably fed respectively to debarker motor **M1** and tractor motor **M3** through lines **L6** and **L7** and control for the respective motors is through respective valves **V3** and **V5**. Interposed between valve **V3** and motor **M1** is a relief valve **RV5**. A relief valve **RV7** is interposed between the valve **V5** and the motor **M3**.

The fluid line **L3** from valve **V1** connects the output of pump **P1** with the feed roll motor **M6**. Control of fluid to this motor is by a valve **V6** and interposed between the valve **V6** and the motor **M6** is a relief or motor overload valve **RV8A**. Serially with motor **M6**, the valve controls the flow of fluid to the conveyor motor **M25** through the line **L8**. In parallel with motor **M25** is a relief valve **RVx** and a flow control valve **MF**. In series with the conveyor circuit is a speedup roll drive motor **M7** connected through a needle valve **NV1**. Fluid from the motor **M7** returns to tank **T** by a line **L9** through a back pressure valve **BPV1** serially connected therein. A relief valve **RV2** is connected to the line **L8** by a line **L10** intermediate the

needle valve NV1 and the motor M25. The relief valve RV2 returns the fluid to the tank T. A pilot line PL1 is connected to the line L9 between the motor M7 and the back pressure valve BPV1 and is connected respectively to master valves V2' and V3' by branch lines PL2 and PL3. The master valves V2' and V3' control respectively slave valves V2 and V3. The pilot line PL1 accordingly interrelates the operation of the feed roll and speed roll motors M6 and M7 respectively with the debarker motor and delimber motor respectively M1 and M2.

The pump P1 is connected to valves V7 and V8 by a line L11. The valve V7 controls the flow of fluid to each of the boom lift hydraulic cylinders **450**, only one of which is shown in FIG. **24**. Valve V8 controls the flow of fluid to the boom winch motor M8. A pressure relief valve RV9 is located in the line L11 intermediate the pump P1 and motor M8. Pressure relief valves RV10 and RV11 are located in respective ones of a pair of lines from the valve V7 to the hydraulic cylinders **450**. A pressure relief or motor overload valve RV12 is connected in series with the control valve V8 and the boom winch motor M8. Each of the valves RV9 to RV11 inclusive have lines returning fluid to the tank T.

The pump P1 supplies fluid to the shears cylinders **958** and the fluid thereto is controlled by a valve V13. Fluid from the cylinders returns to the tank T from the valve V13. The fluid from the pump P1 to the valve V13 is through a line L18 and located therein between the pump and the valve is a standard accumulator system with an unloading valve. An accumulator A1 in the line L18 has a return to the tank T through a needle valve NV3. This valve allows dumping or emptying the accumulator into the tank T. The line L18 also includes a return to the tank T through an unloading valve UV1. One return to the tank is through a line L19, the check valve BP3 in line L18 intermediate unloading valve VV1 and pump P1 prevents discharge of accumulator A1 back to pump P1, and a second return is through a line L21 having needle valve NV4 therein. The line L18, intermediate the accumulator A1 and valve V13, has a branch line L22 supplying fluid to the slewing motor M5 through a valve V11 and the grapple hydraulic cylinder **1466** through a valve V12. The valve V12 is connected to the branch line L22 through a flow control valve FC2. The grapple hydraulic cylinder has an accumulator A2 connected to one end thereof and the accumulator returns to the line intermediate the valve V12 and the hydraulic cylinder by a line L24. Located in line L24 is a normally closed needle valve NV5. A pressure reducing valve PR1 is connected in series with the valve V12 and the grapple hydraulic cylinder **1466**. The rotary hydraulic coupling **1435** is located intermediate the pressure reducing valve PR1 and the hydraulic cylinder **1466**.

A second pilot line PL 4 is connected to the line L8 intermediate the valve V6 and the motor M25. The pilot line PL4 is also connected to a master valve V13' controlling the slave valve V13.

A valve Vx for controlling the off-feed conveyor lift cylinder **590** is connected to the line L22 through a flow control valve FCx. The valve Vx controls the flow of fluid to and from the cylinder **590** and thereby effects raising and lowering of the free end, i.e., the discharge end of the conveyor. A pair of pressure relief valves RVx are located respectively lines LX_1 and LX_2 connecting the valve Vx with opposed ends of the cylinder **590** and a return line to the sump T.

The valve V1 is in a two-position, three-way selector valve controlled or operated by a solenoid S_S. The valves V2 and V3 controlling respectively motors M1 and M2 are slave valves controlled respectively by solenoid-actuated master valves V2' and V3'. The valves V2' and V3' are actuated respectively by solenoids S_L and S_D. The grapple control valve V12 is the same type as valve V1 and is actuated by a solenoid S_C. The shear cylinder control valve V13 is a directional control air-operated valve slave to a master valve V13 controlled by a pair of solenoids S_C and S_O respectively the shear close and shear opening solenoids. The feed roll motor control valve V6 is a three-position, four-way valve actuated by a pair of solenoids S_R and S_F. The valves V4 and V5 are each three-position, four-way manually controlled valves, which for a matter of convenience of construction, are mounted together as a single unit. The valve V11 is a three-position, four-way directional control valve manually operated and controls the motor M5. The valves V7 and V8 are three-position, four-way manual control valves. The valves V7 and V8 are mounted as a single unit and are manually operated valves.

The partial block and schematic diagram in FIG. **24** of the overall hydraulic control system for the processing machine is broken up into several components relative to the various phases of operation. The hydraulic circuits for these phases are shown in considerable detail in FIGS. **25–35** inclusive, the reference numerals on the supply lines to the valves and returns being identified with similar references throughout the group of FIGS. **25–35** thereby illustrating the overall detailed hydraulic system for the machine.

FIG. **25** shows the hydraulic pump P1 and a standard accumulator system having an accumulator A1 and various unloading and dumping valves. FIG. **26** is a schematic of the tractor drive motors and controls therefor. FIG. **27** is a detailed schematic of the hydraulic system and controls for the slewing motor M5. FIG. **28** is a detailed schematic of the hydraulic system for the boom winch motor M8 and boom lift cylinders **1475**. FIG. **29** is a detailed schematic of the hydraulic system and control for the boom grapple cylinder **1466**. FIG. **30** is a detailed schematic of the hydraulic system for the debarker and delimber motors respectively M1 and M2 and the second pump P2. FIG. **31** is a detail of the hydraulic system of the feed roll motor M6 and speed roll motor M7. FIG. **32** is a detail schematic of the hydraulic system for the boom shear cylinders **958**.

Referring now in detail to FIG. **25**, the pump P1 is a fixed displacement split six-bore hydraulic pump driven at approximately 2,200 r.p.m. by the main powerplant providing an input of roughly 140 hp. The pump P1 is connected to a sump or tank T through a filter or strainer F and a needle valve NV10. Two pistons of the pump P1 are connected to the selector valve V1 to deliver thereto approximately 7.2 U.S. gallons per minute. The selector valve V1 is a two-position, three-way manual control valve assembly connected to the tank T. One outlet of the valve is connected to the delimber motor control valve V2 by a line L2 and to the right track control valve V4 by the same line. Another outlet from the valve V1 is connected to the feed roll and speed roll control valve V6 by a line L3. Three pistons of the pump P1 are connected to the boom winch and lift control valves V7 and V8 (see FIG. **28**) by a line L11. A pressure relief valve RV9 (FIG. **31**) is connected to the line L11. Five pistons of the pump supply fluid pressure to the shear control cylinders **958** through the shear cylinder control valve V13 (see FIG. **32**) by a line L18. The back pressure valve BP3 is serially connected in the line L18. The accumulator A1 is also connected to the line L18. There is a return from the line L18 to the sump T through an unloading valve UV1. A further return to sump from the unloading valve is by way of line L20 through the needle valve NV4.

The selector valve V1 is controlled by an electrical solenoid S_S and the circuitry for effecting such actuation will be described hereinafter.

Referring to FIG. **26**, the tractor is driven by the left track motor M3 and the right track motor M4 controlled respectively by valves V5 and V4. Interposed between the motor M4 and the valve V4 is a relief valve RV8. The pressure in these valves is roughly 6,000 p.s.i. The valves V4 and V5 are supplied with fluid by the lines L2 and L7.

Referring to FIG. **27** the slewing motor M5 is controlled by a three-position, four-way directional control valve V11 manually operated by a remote control RMC. Fluid to the valve is supplied through a flow control valve FC3 by the line L21 from the pump P1. Connected intermediate the motor M5 and the valve V11 is a motor overload relief valve RV15.

Referring to FIG. 28 the boom winch motor control valve V8 and the boom lift cylinder control valve V7 are supplied with fluid pressure by the pump P1 through the line L11. The pressure relief valve RV12 is located between the valve V8 and the motor M8. Pressure relief valves RV10 and RV11 are also in respective ones of supply lines to the lift cylinders 450.

Referring to FIG. 29, fluid is supplied to the grapple cylinder control valve V12 by a line L21 through the flow control valve FC2. The valve V12 controls the grapple cylinder 1466 and in series with the valve V12 is a pressure-reducing valve PR1. The rotary coupling 1435 is also in series. Supply of fluid to one end of the cylinder 1466 is controlled by the valve V12. The opposite end of the cylinder is connected to the accumulator A2 containing a compressible fluid pressurized normally to retain the grapple in a closed position. The accumulator may be replenished with fluid from a line L24 connected to the fluid line and controlled by a normally closed needle valve NV5.

Referring to FIG. 30, the pump P2 is connected to a sump or tank T through a needle valve NV15. Fluid pressure is supplied by the pump P2 respectively through lines L5 and L6 to motor control valves V3 and V2. These slave valves are controlled respectively by solenoid-actuated master valves V3' and V2'. The valve V3' is operated by the delimber solenoid S_D and the valve V2' is operated by the delimber solenoid S_L.

Referring to FIG. 31, the line L3, from the selector valve V1, returns to the tank T through a variable-flow control valve FC1. The line L3 also supplies fluid to the speedup roll drive motor M7 and feed roll drive motor M6 and is controlled by the solenoid-actuated valve V6. This valve is operated by a pair of solenoids S_R and S_F.

Referring to FIG. 32, fluid pressure is supplied by line L18 to the hydraulic cylinder 958 of the shear and is controlled by a valve V13. The valve V13 is hydraulically operated and is slave to a master valve V13' which in turn is actuated by a pair of solenoids S_C and S_O. The master valve V13' is supplied by the pilot line PL2 from the feed roll and speedup roll control valve V6.

FIGS. 33 to 35 inclusive illustrate the hydraulic circuits for the delimber. To control the position of the cutters 1621, it is necessary to rotate the cutter arms. This is accomplished by actuation of cylinders 1640. Since the three arms are interlinked by linkages 1646 (see FIG. 8), the cutters 1621 move simultaneously and by the same amount. However, if desired, the linkages 1646 may be disconnected and thereby provide individual control of the movement of the cutterheads toward and away from a common axis.

Turning now to FIG. 33, there is shown a pump P1 connected to a storage tank T. Hydraulic fluid is pumped via line L40 through a valve V40, line L41, filter F2, line L42, to a pair of hydraulic accumulators AC3 and AC4. A fluid return path to the tank T is provided by a relief valve RV40. The accumulators AC3 and AC4 are connected to a control valve V40 by a line L43.

Fluid pressure provided by the pump is selectively fed to the cylinders 1640 by the control valve V40. The four-way valve V40 delivers fluid pressure selectively either to the rod or the head end of the double-acting cylinders. The purpose of the accumulators is to augment the flow of the pump for fast cycling. They are replenished by the pump between cycles, excess oil being relieved through valve RV40 when the accumulators are full.

Actuation of four-way valve V40 is accomplished by means of a flyball mechanism which is responsive to the rotation of the main housing. The flyball is biased towards the axis of the delimber when the delimber is stationary, by a spring. Centrifugal force causes the ball to move outwardly and thereby opening the valve upon rotation of the delimber.

FIGS. 34 and 35 respectively illustrate alternative arrangements for the hydraulic system for the delimber arm control cylinders 1640.

ELECTRICAL CONTROL

The hydraulic system, previously described, is controlled in some cases, manually and in other cases by electric solenoids. FIGS. 1 and 36 to 39 inclusive illustrate the electrical controls and circuits for the machine.

FIG. 1 diagrammatically illustrates the various positioning of the switches with respect to the processing units. Seven sensing switches are utilized, four of which are mounted upon the shear. Three of the sensing switches are mounted upon the feed rolls and preferably on the set adjacent the shear unit. In the processing operation, a tree is engaged by the grapple actuated by the control of the operator and it is fed directly to the delimber unit. The tree then passes respectively through the first set of feed rolls and a shear where the delimbed and debarked tree is severed into selected lengths. During processing the tree moves continuously and in effect the various processes are performed simultaneously at different positions longitudinally along the length of the tree.

The operator control panel includes levers for manually actuating the valves described previously with respect to the hydraulic system. At the operator's station, there is an electrical panel box P (see FIG. 36) enclosing and housing electrical apparatus. A further main control junction box CB (FIG. 37) is located for convenience of wiring at another position not shown on the machine. The upper surface of the panel box P has a plurality of switches whereby the operator may selectively control through electrical circuits various processing units. On this panel are located switches PB3A and PB3B these being respectively the feed roll forward and feed roll reverse switches. A further pair of switches PB4 and PB5 respectively manually control the closing and opening of the shear. Switches PB6A and PB6B are also located on the panel box and are respectively switches for selecting manual or automatic operation as are also switches PB7A and PB7B for controlling respectively raising and lowering of the off-feed conveyor.

The foregoing switches, except for PB7A and PB7B, have respective ones of lights LT1 to LT7 associated therewith visually indicating the condition or electrical state of the circuit for its associated switch. The switches on this panel are connected to a terminal block T1. The terminal T1 is connected to a terminal block T2 located in the main junction control box. Terminal block T1 has pairs of contacts 1 to 16 inclusive and terminal block T2 has pairs of terminals 1 to 49 as indicated respectively on each of the blocks. Connected to terminal block T2 is the flapper switch SW4, a grapple switch PB1 on the grapple-actuating lever, a foot control delimber override switch SW1, and the engine ignition switch. Also connected to the terminal block T2 are the switches SW5 and SW6 which are the shear closed sensing switches; SW8 and SW9 which are proportional-opening shear-sensing switches. Shear open solenoid S_O and a shear close solenoid S_C are also connected to the terminal block T2. Switches SW2, SW3 and SW7 which are tree trunk diameter sensing switches mounted on the second set of feed rolls are also connected to the terminal block T2 of the main control junction box. In addition, connected to the terminal block T2 is a feed roll forward repeater relay KF, a feed roll reverse solenoid KR, a debarker solenoid S_D, master power relay KM, selector repeater relay KS, a delimber solenoid SL and grapple relay KG.

FIG. 38 schematically illustrates the electrical circuit for the entire machine. All contacts for the relays in this schematic are illustrated in the position with the respective or associated relay in a deenergized state. Switches SW5 and SW6 are shown as two separate switches and these two may be replaced by a single switch SW5'.

FIG. 38, a ladder diagram, will now be described with reference to a plurality of parallel circuits A to U inclusive. Each of these circuits includes marks indicating a connection and identified by reference numerals, for example, C1, C2, P2, P3 etc. The prefixes C and P refer respectively to the con-

nections in the control box CB and panel box P, such connections being made to terminal blocks T2 and T1, the numeral indicating the terminal connection on these blocks.

The circuits A to U inclusive are electrically connected in parallel by lines LA and LB having a 24-volt battery connected thereacross as will be seen hereinafter in circuit T. The circuit A includes a switch PB1 in series with the grapple relay KG. The circuit B consists of debarker solenoid S_D in series with switch PB2. A debarker white on-light LT1 is in parallel with the solenoid S_D. The circuit C consists of relay KF which is feed roll forward relay in series with the switch PB3A. A green light LT3 indicating the forward on for the relay is in parallel with the relay KF. Circuit D consists of feed roll reverse relay KR in series with the switch PB3B. A red light LT2 is in parallel with the relay indicating the reverse relay on. Circuit E consists of the delimber solenoid S_L in series with relay contacts K1 and relay contacts K9. Paralleling the relay contacts K1 and 9 is the foot delimber override switch SW1. Circuit F consists of a relay K11, the less than 3-inch log diameter sensing relay which indicates chopping after flapper switch SW4 has been operated. The relay K11 is in series with relay contacts K8, relay contacts K2, relay contacts K4, and this series circuit is connected to the fixed contact NC of switch SW2. The circuit F further includes delimber relay K1 in series with relay contacts K3 and relay contacts K1, the circuit being connected to lines LA and LB and thereby being parallel to circuits A to T. A fixed contact NO of switch SW2 is connected in circuit intermediate relay K1 and contacts K3. The movable contact of switch SW2 is connected to line LA. Circuit G consists of a relay K2, sensing 1½-inch diameter logs which operates from the delimber-sensing switch SW3 in series therewith. Circuit H consists of a delimber hold relay K3 in series with relay contacts K2 and relay contacts K1. Paralleling the contacts K1 are relay contacts K3. Circuit I consists of shear closed relay K4 in series with relay contacts K4, relay contacts K9 and relay contacts K5. In parallel with relay contacts K9 and K4 are contacts K9 and the manual shear close switch PB4. Also in parallel with the relay contacts K4 are relay contacts K10 and the flapper switch SW4. In parallel with relay K4 is the light LT4 indicating the shear closed. Circuit J consists of the shear close solenoid S_C in series with relay contacts K4. Circuit K consists of the shear open solenoid S_O in series with relay contacts K5. The circuit L consists of the shear open relay K5 in series with relay contacts K7, switch SW6, switch SW5, relay contacts K9 and relay contacts K8. Relay contacts K5 are in parallel with serially connected switches SW5, SW6 and relay contacts K7. The switch PB5 and relay contacts K9 are in parallel with the relay contacts K9, switch SW5, SW6 and relay contacts K7. A light LT5 parallels the solenoid K5. The circuit M consists of a 6-inch tree diameter size sensing relay K6 in series with relay contacts K2 and the switch SW7. Circuit N consists of the shear open 6-inch tree diameter sensing relay K7 in series with relay contacts K8, relay contacts K6 and switch SW8. Circuit O consists of shear-opening relay K8, in series with switch SW9. Circuit P consists of a blue light LT6 indicating the manual operation in series with relay contacts K9. Circuit Q consists of serially connected switches PB6A and PB6B respectively the manual and automatic operation selection switches and the relay K9. Paralleling relay K9 is the light LT7 indicating automatic operation. Circuit R consists of chopping relay K10 in series with relay contacts K7 and K11. Circuit S consists of selector relay KS in series with switch PB3A the latter of which is parallel with switch PB3B. Circuit T consists of line T1 connecting a battery BT in series with relay contacts KM and a 20 amp circuit breaker CB to lines LA and LB. A selector solenoid S_S and serially connected relay contacts KS; feed roll forward solenoid S_F and serially connected relay contacts KF are connected in parallel with the battery BT and contacts KM through a 50-ampere fuse or circuit breaker FS2. The grapple solenoid S_G connected in series with relay contacts KG and feed roll reverse solenoid S_R in series with relay contacts KR parallel the battery BT and relay contacts KM and are connected thereto through a 50-ampere fuse or circuit breaker FS3. Motor starter solenoid SKMS is connected in series with a switch ST which parallels the ignition switch and master relay KM, and together are connected across the battery through a 20-ampere circuit breaker FS4 and ammeter AM. A voltage regulator R in series with the generator G is connected across the battery through the ammeter AM. A motor starter S and relay contacts KMS are also connected across the battery.

The circuit U consists of a pushbutton switch PB7A connected in series with a solenoid $S_{C\text{-}R}$ completing a circuit to effect raising of the conveyor. Circuit V similarly consists of a switch and solenoid in series identified respectively as PB7B and $S_{C\text{-}L}$ and controls lowering of the conveyor.

The relay contacts in the various circuits are normally open unless otherwise indicated as in the foregoing description. All relays K1 to 9 inclusive and 11 are Clare type A70061 and relay K10 is an Agastat type DD-G-11 relay having a 0–2 second delay (adjustable). Switch PB2 is an illuminated push on-off switch for example a Honeywell 52PB67-T2 and switches PB3A, 3B, 4, 5, 6A and B are illuminated solenoid interlocked switches, for example Honeywell switches 52PB8-T2. The debarker on switch P62 releases (off) on the second push. Unless the engine is on, none of the push lights will work. The push light switches are mounted in the panel box P.

The control box C.B. serves as a mounting place for 10 Clare 24 v. DC plug-in relays, one Agastat 0–2-second timer, and one master power relay. The master power relay KM disconnects all power from the system if the logging combine engine ignition is off. The Agastat K10 governs the "fast chop" cycle in that a short time delay results in short lengths of log being chopped while longer time settings produce longer logs, since the rolls can move the tree trunks further between chops. Four terminal strips provide 49 connection points for wires to this chassis. Other than K10, there are no adjustments and a defective relay can be quickly replaced due to the plug-in feature. The relays are totally enclosed to keep out dirt.

The following components are mounted in the control box:

K1–9, 11 Clare A700061 (Relay 24-v. DC coil)
K10 Agastat DD-F-11 (0–2 second delay)
KM Potter & Brum MB3D (50-ampere contacts)
Term. strips Jones 12–141 (Through panel type)
Relay sockets 20-pin amphenol 77-Mit-20
Flapper switch SW4 which may be a Honeywell impulse switch 1PDi is remotely located on the machine.

The motor portion of the schematic in FIG. 38 represents the usual standard automotive electrical starter-battery and ignition system. Ignition relay contact KM prevents operation of the rest of system unless motor ignition is on.

The solenoids of the hydraulic system operate via repeater relays because of large momentary Solenoid currents. Example: Relay KG operates Solenoid S_G etc.

OPERATION

In operation, the mobile or self-propelled processing machine is driven into an area of felled trees and preferably positioned adjacent the butt ends thereof. The operator regulates motors M3 and M4 through control valves V3 and V2 respectively, to move the tractor into the desired position. The slewing motor M5 is then operated to rotate the frame 200 on tractor base 100 to position the grapple end of boom 400 adjacent the butt end of the felled tree selected by the operator for processing. The boom is extended and pivoted on its horizontal axis so that the grapple jaws engage the tree trunk at a position spaced from the butt end of the trunk. Preferably, the tree trunk is engaged by the grapple jaws at a point between the butt end of the tree and the tree's center of gravity so that, as the butt end of the tree is elevated by the boom the top of far end of the tree remains resting on the ground.

The hydraulic cylinder 1466 is biased by a compressible fluid in the accumulator A2 such as normally to retain the

grapple jaws in a closed position. Fluid may be selectively admitted to the accumulator to make up for lost fluid through the needle valve NV5. In order to grasp a tree, the valve V12 is operated so as to move the jaws open against the pressure of the compressible fluid and the tree is then engaged by the grapple jaws. The front end of the tree is lifted and fed directly into the first of the processing units by retracting the boom. Feeding of the tree by the boom continues such that the tree is engaged by the first set of feed rolls. The grapple is then released by operating the valve V12 and the selected tree is fed through the processing units by the driven feed rolls **800**. While the tree is being processed, the operator controls the valves for the boom winch motor and grapple cylinders to grasp and feed a second tree to the processing units.

The operation of the cylinder **1466** is made clear with reference to FIGS. **24** and **29**. Opening the valve V12 permits the hydraulic pump P1 to pump hydraulic fluid to the lower chamber of the hydraulic cylinder **1466** forcing piston and rod inwardly into the cylinder portion of the hydraulic cylinder. The jaw **1462** moves upwardly (as viewed in FIG. 4) thus opening the grapple. Hydraulic fluid is forced from the upper chamber of the hydraulic cylinder **1466** through the line **468** to one chamber of the hydraulic accumulator A2. This excess fluid forces the free-floating piston into another chamber of the accumulator A2 which contains nitrogen (or some other compressible gas, e.g., air). As long as the valve V12 is open to connect pump P1 to the system, the compressed gas remains as potential energy.

When it is desired to close the grapple, the valve V12 connecting the pump P1 to the system is closed. This permits the potential energy in the accumulator to be released. This, in turn, forces the free-floating piston and its associated rod downwardly, thereby moving the movable jaw and thus closing the grapple.

An advantage of this sequence for opening and closing the grapple is that more positive gripping of trees is assured through the reserve power residual in the accumulator.

For extending and retracting the boom, winding cable **425** onto windup drum **1430** extends the movable boom section **402** outwardly. Winding the cable **427** onto windup drum **1431** retracts boom section **403**. The cable **426**, anchored at opposed ends to boom sections **401** and **403**, corelates movement of the movable boom sections. The boom is retracted moving the butt end of the tree toward the delimber **600** of the processing machine and feeds it therethrough where it is brought into contact with the spiked rolls of the first set of feed rolls **800**.

Spiked rolls are driven in an infeed direction to feed the butt end of the delimbed tree into the debarker **700** at substantially the same speed as the feed of the retracting boom **410**.

As feeding continues of the delimbed tree by retraction of the boom **410** and movement of feed rolls **800**, the butt end of the tree engages revolving blades **707** of debarker **700** forcing the blades **707** outward on their spring-tensioned pivotal mounting on revolving housing **706** as described in the aforecited patent to Brundell to remove the bark from the tree. As the feeding of the tree continues, the delimbed and debarked end of the tree is engaged by the second set of feed rolls **800** which are rotating at a speed commensurate with the first set. Once the tree is in contact with both sets of the feed rolls **800**, continuation of further feeding of the trees through the processing unit is solely by the feed rolls. With the tree embraced by the spiked rolls of feed rolls, the grapple jaws are opened by the operator thereby releasing the tree.

After grapple **460** has been disengaged, the free end of the tree rests on and is dragged along the ground by the forward feeding action of the feed rolls **800**. To facilitate alignment of the tree longitudinal axis and the axis of the in-line processing units, the subframe assembly is tilted downwardly. The alignment is further facilitated by the pivotal mounting of beams **30** whereby the subframe assembly having the delimber **600**, debarker **700** and shear **900** pivots about a horizontal axis. Thus, the common feed axis of the delimber, debarker and cutoff knife, which may be referred to as the feed path, is free to follow and remain in alignment with the tree. The orientation of the tree with respect to the apparatus may vary somewhat as the tree is initially fed forward first by the grapple and then by the first set of feed rolls **800**. The pivotal mounting of the beams **301** also tends to minimize bending moments which otherwise would result if the tree was not aligned with the feed axis of the delimber, debarker and cutoff knife.

To avoid undue pivotal movement of the subframe assembly **300**, it may be locked if desired with respect to the supporting frames by any convenient means, e.g., the hydraulic cylinders. This may be desired when the knife blades of the shear are in engagement with the advancing delimbed and debarked tree and knife housing is spaced rearwardly away from the delimber **600**. In cases where hydraulic cylinders are used the locking may be accomplished automatically by a suitably located control valve.

In the machine illustrated the majority of the processing operations can be controlled either manually or automatically. Referring to FIG. **2** a tree TR having limbs and branches thereon, is fed into the axially aligned processing units by the boom-and-grapple assembly **400**. The butt end of the tree passes in sequence through the delimber **600**, a first set of feed rolls **800**, a debarker **700**, a second set of feed rolls **800** and the delimbed and debarked tree is then severed into a selected length by the shear unit **900**. The log separated from the remaining portion of the tree trunk falls by gravity on the platform of the off-feed conveyor. The trailing end of the falling log drops onto the driven speed roll **1100** which accelerates the processed log to assist in discharging the latter from the last of the processing units onto the off-feed conveyor. Before the log is severed by the shear unit **900**, the leading end strikes the flapper plate **1002** actuating the flapper switch SW4 thereby readying an electrical circuit for effecting actuation of the shears. A severed log drops onto the platform of the off-feed conveyor, the leading end of the log striking the end wall portion **535A** and the trailing end striking the off-feed roller **1100** and the sloped guide bar **534**. The log is thereby deflected laterally and discharged over the end of the plate **513** onto the chains of the conveyor. The logs, as they are discharged, are engaged in sequence by the lugs **579** on the conveyor chains **577** and **578** as the latter are driven in unison in a counterclockwise direction (as viewed in FIG. **18**).

The logs are discharged from the free end of the conveyor onto a suitable carrier or support, e.g., dropped into a pile on the ground. The free end of the conveyor is raised or lowered as required to minimize the vertical drop of the discharged logs and thereby facilitate maintaining the logs in alignment in the pile.

In the preferred operation, the machine is moved in a generally linear path adjacent the butt ends of the piled raw trees to be processed. The processed trees are discharged in a similar row offset therefrom. The processed logs may be piled in relatively high piles because of the conveyor being pivotally mounted which permits varying the vertical position of the discharge end of the conveyor.

As previously mentioned, the processing machine may be slewed about a vertical axis to facilitate grasping trees with the grapple. This causes the log discharge position to vary and the embodiments illustrated in FIGS. **21** and **22** compensate to a certain extent for this movement whereby the processed logs are deposited in substantially a common row. The specific operation and accomplishment of this is described along with the previous detailed description of the off-feed conveyor.

As is apparent from the foregoing, once the felled tree is grasped by the grapple on the boom, the limbs and bark are removed from the tree and the delimbed and debarked tree is cut into predetermined lengths while the tree being processed moves continuously through the machine. The operations, i.e., the delimbing, debarking and cutting, are performed in sequence but occur simultaneously as the tree moves continuously to provide a continuous operation. The entire processing operation is completed in a simple operation. Once the butt

end of the tree is aligned with the delimber and fed into the feed rolls, the machine handles the tree for delimbing, debarking and cutting, the operator merely determining that the controls for the various units are properly positioned. After the felled trees within the reach of the extended boom have been processed, the machine is readily moved by the operator to the next processing site, ready to process trees at the new site.

The electrical control system automates the operation of the logging combine so that the combine operator need only attend to picking up cut trees with the grapple and feeding these trees into the intake rolls of the machine. Control of the automated portion of the system can be overridden thus reverting to manual control.

The combine removes substantially all of the limbs from the trees, debarks the trunks, and senses the diameter of the resulting tree trunk. The trunk/log advances forwardly through open shear blades which, by the proportional-opening sensing switches, open just enough to accommodate the trunk.

When the log hits the flapper plate (**1002**) 8 feet beyond the shear or some other selected length depending upon the positioning of the flapper plate, the shear closes cutting an 8-foot length. The operation repeats until the trunk diameter is down to approximately a 3-inch diameter as the treetop approaches. The delimber stops and the shear fast chops the remaining length into short billets of length set by the adjustable time **K10** period. When the trunk diameter is less than approximately 1.5 inches, the combine resets itself to receive the next tree.

The electrical system controls mechanical movements by relays which activate hydraulic solenoid valves, as shown in FIGS. **24** to **35** inclusive.

The control panel CP to the right of the operator has seven "pushlight" switches with illuminated caps, (see FIG. **36**). The first push of the top white one, switch **PB2**, turns on the debarker and the internal lamp indicates that it is on. (A second push releases the button and turns the debarker off.) Pushing green and red pushlights **3A** and **3B** starts the feed rolls moving either forward or reverse. The forward pushlight is self-holding while reverse pushlight must be held down to maintain contact. The operator switches on the debarker and feed roll motors; depresses white **PB2** and green **PB3A** causing the debarker to run and rolls to move forward; and pushes white "auto" button **PB6B**.

The operator then places the boom over a tree. To open the grapple the pushbutton switch **PB1** located at the top of the grapple lever is depressed. It remains open as long as the pushbutton is depressed. Releasing the button closes the grapple jaws.

The operator then feeds a tree, butt first, directly into the combine with the grapple where the tree is picked up by the feed rolls **800** and pulled into the machine.

The sensing switches attached to the second feed roll performs the following functions:

a. Senses entry of all trees greater than 3 inches in diameter and activates the delimber.
b. Determines if trunk diameter is greater than or less than 12 inches. If less than 12 inches the shear will open only to 12-inch diameter position after first cut has been made.
c. Senses when trunk diameter is less than 3 inches and starts fast chop cycle.
d. Senses when trunk diameter is less than 1½ inches and then opens shear to maximum 18-inch diameter position and stops delimber.

A second pushbutton switch **SW1** on the grapple lever is provided so that the operator can override (d) and actuate the delimber at will.

Thus during normal automatic operations the operator need only continually feed trees into the combine with the grapple.

As soon as a tree enters the rolls the delimber and debarker operate. The shorn trunk moves through wide-open shears until the flapper plate is struck. Striking the flapper plate actuates the shear close solenoid Sc. The shears operate and continue closing until the shears closed switches **SW5** and **SW6** contact. The 8-foot log cut falls into the cradle and shears begin to open. If tree is less than 12 inches in diameter, the shears stop opening at 12 inches. If tree is greater than 2-inch diameter, the shears open wide to 18-inch diameter. The shears remain open until flapper plate **1002** is again struck and the cycle repeats.

When the tree trunk is sensed as being less than 3 inches in diameter, the shear begins a fast chop cycle that cuts the remaining portion of the tree into short lengths. As the trunk diameter reduces to less than 1.5 inches, the combine stops and resets wide open for the next tree with delimber stopped.

All functions which are normally automated may be transferred to manual operations if the operator pushes blue "manual" pushlight switch **Pb6A**. In this mode one pushes the pushlights and the internal pushlight lamps will come on indicating that this function is operating. In auto operation the appropriate lamps will flash without human intervention. The rolls can be reversed manually to position or remove a tree from the combine.

A chart of switch and relay functions is given below, reference being made particularly to FIGS. **37** to **39**.

Pb1 Open grapple button on grapple handle
SW1 Delimber override button on grapple handle
SW2 Senses tree greater/less than 3 inches diameter
SW3 Closes when tree greater than 1.5 inches diameter
SW4 Momentary flapper plate closes when butted
SW5 Closes when shears completely closed
SW6 Closes when shears completely closed
SW7 Opens when tree greater than 12 inches diameter
SW8 Closes when shears open more than 12 inches diameter
SW9 Open when shears open more than 18 inches diameter
K1 Auto starts delimber if **SW1** is not used
K2 Sense 1.5 inches or more tree diameter
K3 Delimber hold relay
K4 Closes shear
K5 Opens shear
K6 6 inches tree sensing
K7 12 inches diameter shear open
K8 18 inches diameter shear open
K9 Auto/manual transfer relay
K10 0–2 time delay for fast chop cycle
K11 Fast chop cycle
KM Master power relay interlock with ignition switch/starter
K_G, K_S, K_F, K_R Four repeater relays mounted near solenoids
K_G Grapple Relay
K_S Selector Relay
K_F Feed roll forward Relay
K_R Feed roll reverse Relay

MANUAL OPERATION

Operator depresses "manual" **PB6A**, circuit Q deenergizing **K9** relay and lighting blue lamp inside the pushbutton. **K9** contacts in circuits I and L transfer control of the shear to panel pushbuttons **PB4**, (circuit I) and **PB5** (circuit L). Control of debarker, grapple and feed rolls is always manual via switches **PB1**, **PB2**, **PB3A** and **PB3B** (circuits A–D). Selector relay K_S (circuit S) is energized whenever rolls are moving (forward or backwards) via **PB3A** or **PB3B**.

AUTOMATIC OPERATION

Operator depresses "auto" switch **PB6B** (circuit Q) on panel P energizing **K9** relay which deenergizes blue "manual" lamp **LT6** (circuit P); energizes white lamp **LT7** inside the "auto" pushbutton; and **K9** contacts in circuits L and I transfer shear control to automation circuitry. Deenergized **K2** contacts (circuit L) energizes solenoid **K5** and opens shear knives **964** until solenoid **K8** (circuit O) electrical stop halts shear at 18 inches diameter maximum via **K8** contact (circuit L).

The operator opens/closes grapple jaws **1461** and **1462** via switch Pb1 (circuit A) button on grapple control lever. The debarker turns on via switch PB2 (circuit B) and a white lamp LT1 indicates that it is running. The feed rolls **800** are manually controlled by green pushlight switch PB3A for forward (circuit C) and red switch RB3B for reverse (circuit D).

A tree is fed into the waiting combine by the use of the grapple **460** where the forward rolls **800** catch it and pull it in. Automatic operation then occurs as follows:

Sensing switches on the rolls sense the size of the tree. If greater than 3 inches diameter; K2 energizes and SW2 (circuit F) energizes the delimbing device **600** by K1 contacts (circuit E) and the "delimb" Solenoid S_L operates, delimbing the tree trunk. Should the trunk taper off to less than 3 inches diameter, but still greater than 1.5 inches diam. then K3 contact (circuit F) of self-latch relay K3 (circuit H) will hold K1 (circuit F) delimb relay on despite switch SW2 (circuit F) release until the tree becomes smaller than 1.5 inches diameter such that switch SW3 opens dropping out K2 Relay (circuit G) and its contact (circuit H); dropping out K3 delimb "hold" Relay (circuit H) and opening shear blades **964** via K2 contact (circuit L).

The delimbed tree trunk moves through a debarking device controlled by switch PB2 and the debarked tree trunk is propelled by speed roll **1100** endwise through a normally open shear until it rams the flapper plate switch SW4 (circuit I) 8 feet beyond the shear. SW4 closes momentarily energizing self-latching shear close relay K4 (circuit I) and the "shear closed" lamp inside manual switch PB4 (circuit I). The shear blades **964** close, cutting off an 8-foot log which is propelled by speedup roll **1100** off-loading device **500**. The act of closing the shear blades trips two shear-mounted switches SW5 and SW6 which activate self-latch "shear open" Relay K5 through closed K8, K9, K7 contacts (circuits L). K8 is a safety relay which is normally energized and which deenergizes via SW9 (circuit O) to block shear open function if shear attempts to open wider than a 9-inch radius (**18** inches diameter tree).

Energized K5 contact interrupts and resets K4 shear close relay (circuit I) and causes the shear blades to open. If the tree trunk is less than 12 inches diameter the shears do not need to open to maximum. Current will flow through closed tree-sensing switch SW7 contact; through closed (larger than 1.5 inches) K2 contact and energize solenoid K6 (circuit M). Closed K6 and K8 contacts prepare a circuit for shear position switch SW8 which closes when the shear blades pass the 12-inch diameter mark on their way open. The thus energized K7 Relay (circuit N) arrests further open motion via its open contact (circuit L) in series with K5 shear open relay. The debarked tree trunk slides forward through the open shear driven by the forward rolls. A deenergized K5 contact (circuit I) has restored the K4 "close" circuit to readiness to repeat the entire shear cycle when tree trunk end rams flapper switch SW4 (circuit I) again. Thus the tree trunk is delimbed, debarked (if desired) and cut into 8-foot lengths. The reason that size-sensing SW7 on the rolls controls the shear opening is to conserve hydraulic oil pumping when it is unnecessary to open shears to widest amount (18 inches diameter).

As the tree is cut into 8-foot logs, the trunk grows smaller as the top is approached until a new decision must be made. When the trunk diameter has become less than 3 inches; SW2 (circuit F) flips from K1 (12-inch 8-foot log) to K11 "fast chop cycle" (circuit F).

FAST CHOP CYCLE

A large trunk dwindles to less than 3 inches diameter. Tree-sensing SW2 goes to N. C. K2 contact is closed due to "larger than" 1.5 inches diameter. K8 contact is closed because K8 is energized via shear sense switch SW9 (which is normally closed unless shear blades are wide open beyond 9-inch radius. The shear opening should be less than 9 inches because of a small log less than 3 inches in diameter).

When this last log passes, K4 relay shears close (momentary SW4 flapper) and allow current to flow via K4, K2, K8 contacts (circuit F) to K11 which latches on after K4 releases via latch contact. K11 contact and K7 contact energized K10 timer (circuit R). During K10 time period (0–2 sec.) the tree slides forward through open shears. At end of K10 period its contact closes and initiates K4 (circuit I) shears chop cutting a short lot of length determined by K10 period. At completion of shear-closed chop motion switches SW5 and SW6 on shear close indicating completion of chop and K5 (circuit L) is energized and latched reopening shear again.

Fast chop cycle repairs as long as the log is less than 3 inches in diameter and more than 1.5 inches.

When the sensed SW3 tree trunk is nonexistent or less than 1.5 inches diameter; K2 (circuit G) will be deenergized and its contacts (circuits F, H and L) will block off solenoid K3 (circuit H) which in turn will drop out K1 delimber relay (circuit F) stopping the delimbing blades, the fast chop cycle, opens the shear, and generally resetting all relays for the next tree. Any small sticks still in machine will be carried through the open shear by the rolls **800** and discarded. The operator can, if desired, override the dropout of K1 by a button switch SW1 mounted on one of the control levers and thus operate the delimbing blades at will. All relays are shown in the allpower-off position and that this is not the normal operating condition; some are being almost continually energized when the equipment is in use. The lights inside the pushbuttons or "-pushlights" will light when that button is pushed in manual; indicating that the function is being performed. In automatic operation, the shear push button blights will flash without human intervention and this is normal. As an option, the 1½-inch sensing switch SW3 may be disconnected and K2 wired to energize along with S_L delimber solenoid on any tree trunk larger than 3 inches and with delimber "override" SW1. In the fast chop cycle, the severed short lengths of logs are dropped onto the ground.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A machine for processing trees comprising in combination:
   a. a first support;
   b. a second support pivotally mounted on said first support to pivot about a substantially vertical axis;
   c. tree-processing means, on said second support, including processing units to delimb, debark or sever a tree and having a discharge end from which a processed tree length is discharged and;
   d. a log-handling unit comprising a driven conveyor carried by said first support and pivotally arranged in relation thereto to pivot about a vertical axis to collect processed tree lengths discharged from the tree-processing means and convey the same to a selected location removed from said machine.

2. A machine as defined in claim 1 wherein said first support comprises a movable carrier.

3. A machine as defined in claim 2 wherein carrier is a self-propelled mobile vehicle.

4. A machine as defined in claim 3 wherein said log-handling unit includes a third frame secured to said machine and having a generally flat upper surface to receive processed logs discharged from the processing units, a fourth frame pivotally secured to said third frame for movement about a substantially horizontal axis and projecting laterally from the normal path followed by a tree during processing thereof, a driven conveyor extending longitudinally of said fourth frame and means to pivot said fourth frame about said horizontal axis selectively to raise and lower the end of the conveyor remote from the pivotal connection of the fourth frame to said third frame and thereby selectively vary the vertical position of the discharge end of the conveyor.

5. A machine as defined in claim 4 wherein said fourth frame comprises pivotally interconnected members effectively defining a parallelogram of selectively variable angular orien-

tation and said conveyor comprises a pair of endless beltlike members disposed respectively adjacent respective ones of a pair of parallel members of said parallelogram and supported thereby.

6. A machine as defined in claim 5 including linkage means interrelating pivotal movement of said second and fourth frame about their respective vertical pivot axes in opposite directions with respect to one another.

7. A machine as defined in claim 4 including further means pivotally connecting said fourth frame to said third frame for selected pivotal movement about a vertical axis.

8. A machine as defined in claim 3 including means pivotally mounting said log-handling unit on said second support for limited movement about a substantially vertical axis offset from the vertical pivot axis of said second support.

9. A processing machine as defined in claim 3 wherein said log-handling unit comprises in combination a conveyor and a log-deflecting means interposed between said conveyor and the processing means.

10. A processing machine as defined in claim 9 wherein said conveyor extends in a direction projecting laterally from a path normally followed by a tree during processing thereof.

11. A processing machine as defined in claim 3 wherein said log-handling unit comprises in combination log-deflecting means and a driven conveyor.

12. A processing machine as defined in claim 11 further including at least one driven speedup roll located intermediate said processing means and the driven conveyor.

13. A processing machine as defined in claim 11 wherein said conveyor comprises at least one endless-beltlike member having a plurality of lugs projecting therefrom engaging trees conveyed by said conveyor to a selected location.

14. A machine as defined in claim 3 further including in combination therewith at least one roller located between the processing means and said conveyor, said roller facilitating transfer of the processed trees discharged from the processing unit to a conveyor portion of the log-handling unit.

15. A machine as defined in claim 14 wherein said roller is driven.

16. A machine as defined in claim 3 wherein said driven conveyor is pivotally mounted to move about a horizontal axis and means to controllably pivot the same about said horizontal axis selectively to vary the position of said discharge end.

17 A machine as defined in claim 1 wherein on said first support and said conveyor pivot about a common vertical axis.

18. A machine as defined in claim 1 including means pivotally mounting said log-handling unit on said first support for movement about a substantially vertical axis, said pivot axis being common to the vertical pivot axis of said second support and movable irrespective of pivotal movement of said second support.

19. A machine as defined in claim 1 including means pivotally mounting said log-handling unit on said first support for movement about a substantially vertical axis, said pivot axis being common to the vertical pivot axis of said second support, said log-handling unit including a log discharge end and means effecting pivotal movement of said discharge end in response to pivotal movement of said second support and in a direction opposite thereto.

20. A machine as defined in claim 1 wherein said tree-processing means comprises at least two processing units adapted to perform different-processing operations on a tree, said processing units being spaced longitudinally relative to one another along the path a tree follows in passing through the processing units during processing thereof.

21. A machine as defined in claim 1 wherein said tree-processing means comprises at least a delimber and a shear spaced longitudinally relative to one another along the path a tree follows in passing through the processing units during processing thereof.

22. A machine as defined in claim 1 wherein said tree-severing device comprises a shear slidably mounted on said second support and means selectively moving said shear along a path followed by the tree being processed whereby the tree may be severed while moving continuously along said path.

23. A machine as defined in claim 1 wherein said processing means comprise processing units secured to a subframe pivotally mounted on said second support to pivot about a substantially horizontal axis.

24. A machine as defined in claim 1 wherein said processing means comprise processing units individually secured to common rigid members pivotally mounted on said second support for limited movement about a substantially horizontal axis.

25. A processing machine as defined in claim 1 wherein said log-handling unit comprises in combination a conveyor and a log-deflecting means interposed between said conveyor and the processing means wherein said tree-processing means comprises at least two processing units adapted to perform different processing operations on a tree, said processing units being spaced longitudinally relative to one another along the path a tree follows in passing through the processing units during processing thereof.

26. A processing machine as defined in claim 1 wherein said log-handling unit comprises in combination a conveyor and a log-deflecting means interposed between said conveyor and the processing means, said machine further including at least one driven speedup roll located intermediate said processing means and the driven conveyor.

27. A processing machine as defined in claim 1 wherein said conveyor consists of a pair of endless-beltlike members disposed in substantially spaced-parallel relationship and each having a plurality of lugs projecting therefrom engaging trees conveyed by said conveyor to the selected location.

28. A processing machine as defined in claim 27 wherein said endless-beltlike members consist of link chains.

29. A processing machine as defined in claim 27 wherein the lugs on one endless-chainlike member are connected to respective ones of the lugs on the other of the endless-chainlike members to provide, in effect, a series of paddle wheels engageable with the processed trees being conveyed to a selected location.

30. A processing machine as defined in claim 2 including a boom-and-grapple assembly mounted thereon selectively to engage a selected prefelled tree from a plurality of prefelled trees and introduce said selected tree to said processing units.

31. A processing machine as defined in claim 30 including at least one set of feed rolls selectively to feed in sequence trees to be processed through said processing means.

32. A machine as defined in claim 1 including log-measuring means effecting actuation of the tree-severing device to sever a tree being processed into selected lengths.

33. A machine as defined in claim 1 wherein said log-handling unit comprises:

a. a first frame assembly having a log-receiving upper surface;

b. a conveyor assembly pivotally secured to said frame for movement about a substantially horizontal axis, said conveyor assembly extending laterally from said frame and comprising at least one driven member having spaced-apart log-engaging members movable to propel a log away from said frame and discharge such log at a selected location;

c. deflector means disposed normally in the path of a log discharged into the log-handling unit to shift such log laterally toward the conveyor assembly; and

d. means selectively to pivot said conveyor about its pivot axis to raise and lower the discharge end of the conveyor.

34. A log-handling unit as defined in claim 33 wherein said conveyor is laterally offset from the log-receiving upper surface of the frame.

35. A log-handling unit as defined in claim 33 wherein said deflector includes at least one member having a portion overlying the log-receiving upper surface of the frame, said portion of the member sloping downwardly in a direction toward the conveyor assembly.

36. A log-handling unit as defined in claim 33 wherein said deflector comprises a further conveyor disposed in end-to-end relation with the first-mentioned conveyor, said further conveyor having spaced-apart log-engaging members movable to propel a log from said frame onto said first-mentioned conveyor.

37. A log-handling unit as defined in claim 33, further including a hopper assembly secured to said frame and extending vertically above said log-receiving upper surface.

38. A log-handling unit as defined in claim 33, including means to detachably secure the same to a processing machine.

39. A log-handling unit as defined in claim 33 wherein said conveyor consists of at least one endless-beltlike member having a plurality of lugs projecting therefrom.

40. A log-handling unit as defined in claim 33 wherein said frame comprises a rigid longitudinally extending member and said conveyor consists of two or more generally parallel spaced-apart endless-beltlike members extending in a direction substantially normal to the length of said frame.

41. A method of logging comprising:

a. maneuvering a vehicle having processing units and an off-feed conveyor mounted thereon into an area of felled trees;

b. rotating the processing units and off-feed conveyor assembly about respective vertical axes to position the same for handling of trees located in proximity of the vehicle;

c. feeding said trees in successive relation to the processing units mounted on said vehicle;

d. processing said trees in said successive relation;

e. discharging the processed trees from the last of the processing units in the form of whole logs having discrete lengths; and

f. conveying said logs successively from said machine and depositing the same in stacked relation at a selected location removed from said machine.

42. A method as defined in claim 41 including the step of continuously moving a tree along a selected path during processing thereof.

43. A method of processing trees comprising:

a. positioning a processing plant having one or more processing units and an off-feed conveyor thereon and a concentration of full trees in a selected relative position with respect to one another;

b. rotating the processing units and off-feed conveyor assembly about respective vertical axes to position the same for handling of trees located in proximity of the vehicle;

c. extending a boom and grapple outwardly from said processing plant;

d. selecting and grasping an individual tree in said concentration of trees;

e. retracting said boom and grapple along with the tree in a direction toward the processing plant;

f. introducing the tree to a processing unit of said plant;

g. processing said tree and discharging the same from the last of the processing units in the form of whole logs having discrete lengths; and

h. conveying and stacking said logs in parallel relationship with respect to one another at a position removed from said machine.

* * * * *

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,642,041 Dated February 15, 1972

Inventor(s) Douglas D. Hamilton and Joseph J. R. Boivin

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the first or front page of this patent in the left hand column under the paragraph entitled "Assignees:", the first named Assignee should be corrected by changing the word "Internal" to -- International --.

Signed and sealed this 10th day of October 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents