REPAIR INSTRUCTIONS

URSUS C-355

Z A K Ł A D Y M E C H A N I C Z N E „U R S U S"
URSUS k/WARSZAWY POLAND

TRACTOR
URSUS C-355

SUPPLEMENT

to the Instruction Covering the Stripping, Reassembling and Repairs of URSUS C-350 TRACTOR

Manufacturers: ZAKŁADY MECHANICZNE „URSUS"
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CONTENTS

INTRODUCTION

The URSUS C-355 tractor presents the modernized version of the URSUS C-350 model. This instruction is a supplement to the one covering the stripping, re-assembling and repairs of the C-350 tractor and applies to assemblies which have undergone essential changes in the course of modernization.

We advise you therefore to refer while stripping, re-assembling and repairing the URSUS C-355 tractor to the service instruction covering the C-350 tractor with consideration given to the changes listed in this supplement.

Changes as introduced in the C-355 do not, in their overwhelming majority, affect the stripping and re-assembling operations as listed for the C-350 tractor model. Differences noted in this respect are concerning mainly the oil filter in the engine, the P.T.O. shaft, the foot brake control system, the front suspension, and the steering gear.

Lock up the consecutive Chapters for the C-355 tractor specification data, as well as descriptions of construction, stripping, re-assembling and repair of assemblies having undergone changes.

1. URSUS C-355 TRACTOR SPECIFICATION DATA

1.1. ENGINE

Engine designation	— S-4002
Engine type	— Diesel
Cylinder arrangement	— in line, vertical
Operation type	— four-stroke
Injection system	— direct
Number of cylinders	— four
Bore	— 95 mm
Stroke	— 110 mm
Average piston speed	— 7.34 m/sec
Cubic capacity	— 3120 cu.cm
Number of compresion rings	— 3 per piston
Number of scraper rings	— 2 per piston
Rated output	— 55 HP (SAE)
Working speed at rated output	— 2000 r.p.m.
Maximum torque	— 21 kgm
Working speed at maximum torque	— 1500 r.p.m.
Minimum idle run speed	— 500 r.p.m.
Compression ratio	— 17:1
Valve arrangement	— o.h.v.
Intake valve opening before TDC	— 6°
Exhaust valve closing after BDC	— 44°
Exhaust valve opening before BDC	— 40°
Exhaust valve closing after TDC	— 10
Valve clearance size (with cold and hot engine alike)	
Intake valve	— 0.18—0.22 mm
Exhaust valve	— 0.28—0.32 mm
Intake valve diameter	— 39.2 mm
Exhaust valve diameter	— 33.2 mm
Fuel supply system	— plunger type pump
Firing order	— 1—3—4—2
Injection pump type	— P24T8-3. 71 BIFVR
Speed governor type	— R8V20-120/74 D
Fuel supply pump type	— V2HFO1A
Fuel filter type	— twin chamber FVD10RP1.8 felt-and-paper insert
Injector type	— WJ1S78-8 & WJ1S78-9
Injector nozzle type	— D1LMK 150/W2
Delivery commencement angle (injection advance angle) before TDC	— 20°±1°

Injection pressure	— 160+1 kg/cj.cm
Lubrication system	— mixed-forced circulation and splash
Oil pressure at minimum idle run speed	— min. 1.2 kg/sq.cm
Oil pressure at maximum permissible engine speed	— 3.5 $^{+1}_{-0.3}$ kg/sq.cm
Oil pump	— gear driven
Oil filter	— centrifugal
Cooling system	— water, forced circulation, with pump and thermostat
Cooling system heat dispersion	— radiator and fan
Air cleaner	— oil bath, with whirl action
Electrical equipment	— single cable (minus earthed)
Electrical equipment rated voltage	— 12 V
Dynamo P20d	— 150 W
Dynamo regulator RG15d	— 12 A
Starter motor R7a	— 4 HP
Storage battery type	— 3SE-160 (6 V, 160 Ah)
Number of storage bateries	— two
Dry engine weight	— 370 kg
Basic engine overall dimensions (air cleaner not included):	
— length (over flywheel and water pump)	— 880 mm
— width	— 528 mm
— height	— 804 mm

1.1.1. Hourmeter (engine run meter)

— drive through gear train from governor camshaft, transmission ratio between crankshaft and hourmeter cable 2:1

1.2. AIR COMPRESSOR UNIT

Number of cylinders	— one
Bore	— 62 mm
Stroke	— 42 mm
Rated working speed	— 1000 r.p.m.
Air delivery at rated speed	— 90 l/min
Rated pressure	— 6 kg/sq.cm

1.2.1. Pneumatic installation for trailer brake control

Working pressure	— 4.8—5.3 kg/sq.cm

1.3. DRIVE TRANSMISSION SYSTEM

Clutch type	— dry, friction
Clutch system	— two-stage, dry, friction, one disc for each stage, friction lining diameter 280/165 mm
Gearbox type	— mechanical
Gear shifting system	— mechanical
Gearbox position	— integral with the engine and rear axle
Number of speeds forward/ /reverse	— 5/1
Extra reduction transmision	— accommodated inside the gearbox housing
Total forward/reverse speeds speeds number	— 10/2
Transmission ratios of gearbox	
— with reduction unit engaged	$i_1 = 22.73$ $i_2 = 15.28$ $i_3 = 10.96$ $i_4 = 7.14$ $i_5 = 4.28$ $i_{w1} = 17.42$
— with reduction unit disengaged	$i_6 = 5.32$ $i_7 = 3.57$ $i_8 = 2.56$ $i_9 = 1.67$ $i_{10} = 1.00$ $i_{w2} = 4.07$

1.4. REAR AXLE

Driven axle	— rear — through final drive and reduction gears
Final drive type	— bevel gears with Gleason teath
Transmission ratio:	
— final drive	— $i_g = 4.077$
— reduction gears	— $i_r = 4.563$
Differential mechanism	— capable of interlocking

1.5. HYDRAULIC POWER LIFT AND IMPLEMENT LINKAGE SYSTEM

Hydraulic power lift type	— incorporating automatic control system
Working cylinder	— single-action system
Bore	— 80 mm

Stroke	— 150 mm
Hydraulic pump type	— gear driven
Maximum working pressure	— 120 kg/sq.cm
Hydraulic pump delivery (at 1200 r.p.m. speed)	— 20 l/min
Implement linkage system	— three point suspension lever system
Lifting capacity at ends of bottom links	— 1200 kg
Lifting time	— 3 sec

1.6. IMPLEMENT TOWING SYSTEM

Towing hook	
Swinging hitch	— five-positional
Hitching beam	— optional extra, permissible vertical load 300 kg

1.7. UNDERCARRIAGE MECHANISMS AND STEERING SYSTEM

Front suspension	— rigid axle, swing mounted on pivot
Rear suspension	— rigid
Camber angle	— 6°30'
Castor angle	— 3°30'
Wheel toe-in	— 4—10 mm
Number of front/rear wheels	— 2/2
Tyre size:	
— front wheels	— 6.00—18"
— rear wheels	— 13—28"
Wheel rims:	
— front wheels	— 4.00E×18
— rear wheels	— W12 × 28
Tyre pressure: with field jobs:	
— front wheels	— 2 kg/sq.cm
— rear wheels	— 0.8 kg/sq.cm
Tyre pressure: with transport jobs:	
— front wheels	— 2 kg/sq.cm
— rear wheels	— 1.5 kg/sq.cm
Steering gear type	— helical-and-globoidal
Steering gear transmission ratio	— 23.5
Stub axle control system	— single drag link, trapezoidal
Steering system transmission ratio	— 17.0

1.8. BRAKES

Main brake	— drum and shoe type, hydraulic operated, incorporating self-servomechanism foot actuation system, independent for both rear wheels
Brake drum diameter	— 220 mm
Brake shoe friction lining width	— 60 mm
Acting friction area of brake linings	— 2×234 sq.cm
Hand parking brake	— band type, mechanical, independent from main brake
Drum diameter, hand brake	— 234 mm
Band width, hand brake	— 50 mm

1.9. LEADING OVERALL DIMENSIONS OF TRACTOR

Wheelbase	— 2125 mm
Front wheel track	— 1350 and 1750 mm respectively
Rear wheel track	— 1350, 1425, 1500, 1575, 1650, 1725, 1800 mm
Tractor ground clearance	— 440 mm
Minimum turning radius:	
— independent brakes not applied	— 3650 mm
— independent brakes applied	— 3200 mm
Towing hook elevation	— 815 mm
P.T.O. shaft end-piece elevation	— 655 mm
Swinging hitch elevation	— 413 mm
Front hook elevation	— 640 mm
Maximum length	— 3570 mm
Maximum width (with 1425 mm wheel track)	— 1800 mm
Maximum tractor height:	
— driver's cab not included (up to silencer outlet)	— 2050 mm
— including driver's cab	— 2230 mm

1.10. WEIGHTS AND LOADS

Minimum tractor kerb weight (less ballast weights, belt pulley attachment, tool equipment, driver's cab, swinging hitch, transport hook, pneumatic installation)	— 2120 kg

Tractor kerb weight (including ballast weights, no belt pulley attachment, no tool equipment, driver's cab, swinging hitch, transport hook, pneumatic installation)	— 2600 kg
including load on:	
— front axle	— 940 kg
— rear axle	— 1660 kg
Driver's cab weight	— 130 kg
Belt pulley weight	— 33 kg
Weight of rear wheel ballast weights (2 × 36 kg + + 6 × 35 kg)	— 282 kg
Weight of front axle ballast weights	— 105 kg
Weight of front wheel ballast weights	— 90 kg
Weight of water ballast inside rear wheel tyres	— 300 kg

1.11. OPERATIONAL DATA

Theoretical tractor riding speeds with 13—28" size tyres, at n_s = 2000 r.p.m.

	over reduction unit	reduction unit not engaged
1st gear	1.13 km/h	4.82 km/h
2nd gear	1.67 km/h	7.17 km/h
3rd gear	2.34 km/h	9.99 km/h
4th gear	3.59 km/h	15.34 km/h
5th gear	5.99 km/h	25.60 km/h
reverse	1.47 km/h	6.29 km/h

P.T.O. shaft speed at n_s = 2000 r.p.m.
Independent drive 541.6 r.p.m.
Dependent drive from gearbox (constant speed at normal and step-down speeds):

in 1st gear	— 227.67 r.p.m.
2nd gear	— 338.78 r.p.m.
3rd gear	— 472.10 r.p.m.
4th gear	— 724.72 r.p.m.
5th gear	— 1210.50 r.p.m.
reverse	— 287.17 r.p.m.
P.T.O. shaft speed for trailer drive, in step-down gears, with 13—28" size tyres	— 12 122 r.p.m.
Belt pulley diameter and width	— 250 and 150 mm respectively
Belt pulley speed in 5th gear with n_s = 2000 r.p.m.	— 1153 mm
Belt pulley speed with independent P.T.O. shaft drive	— 516 r.p.m.

(540 r.p.m.) at n_s = 2000 r.p.m.

Rotary and peripheral speeds of the belt pulley driven by the gearbox output shaft, in the individual gear positions at n_s = 2000 r.p.m.

	Rotary speed	Peripheral speed
in 1st gear	216 r.p.m.	2.83 m/sec
2nd gear	322 r.p.m.	4.22 m/sec
3rd gear	449 r.p.m.	5.88 m/sec
4th gear	680 r.p.m.	8.91 m/sec
5th gear	1153 r.p.m.	15.10 m/sec
reverse	282 r.p.m.	3.69 m/sec

1.12. CAPACITIES

Cooling system	— 11 l
Fuel tank	— 70 l
Engine oil sump	— 10 l
Injection pump and speed governor	— 1 l
Air cleaner oil bath	— 1.9 l
Gearbox	— 25 l
— when operating in mountainous regions with hydraulic power lift engaged	— 31 l
Reduction gears (total)	— 3 l
Steering gear housing	— 1 l
Belt pulley attachment housing	— 0.9 l
Hydraulic power lift	— integrated with gearbox and rear axle oil circulation
Brake fluid volume capacity in hydraulic brake system:	
— total capacity	— 0.57 l
— reservoir capacity	— 0.425 l

1.13. OPTIONAL EXTRAS (SUBJECT TO AN EXTRA ORDER)

Driver's cab complete with electrical equipment. Belt pulley attachment.

Hitching beam for farm implements according to DIN standard regulations (1-st Category

ISO), or to PN Polish Standard requirements (2-nd Category ISO).

External hydraulic circulation system installation (2 quick acting unions on the hydraulic power lift casing).

Plugs for quick acting unions and plug sockets for the external hydraulic circulation system installation.
Bottom exhaust pipes.
Front axle ballast weights.
Bench for the driver's assistant.

2. ENGINE LUBRICATION SYSTEM

The course of oil circulation is illustrated in Diagram in Fig. 1.

The gear operated oil pump 3 forces oil from the engine oil sump 1 through the centrifugal filter 5, to the main oil duct 7 inside the engine block. Hence, oil is supplied to:

— the bearings of the camshaft 8 and to the crankshaft main bearings 9, and hence through drillings inside the crankshaft, oil penetrates to the connecting rod big end bearings 10,
— the tappets 11, then through the tappet rods 12, to the valve rockers 13.

Cylinder liners and gudgeon pins are lubricated with oil mist. Oil pressure is supervised by means of the pilot (red) lamp integrated in the instrument cluster on the control panel. The lamp glowing up marks a pressure drop within the lubrication system, below the value permissible.

The level of oil inside the engine oil sump is checked by means of the dipstick indicator 15.

2.1. OIL FILTER FUNCTIONING

The construction of the oil filter is presented in Fig. 2.

Oil flows under the pressure action exerted by the oil pump, through the duct 1, to the oil filter impeller.

Following the impeller chamber 2 bein filled up, a portion of oil penetrates through the tubes 3, to the two nozzles 4. Oil issuing out of the nozzles under pressure, forces the impeller to rotate, on the principle of jet reaction.

Rotary speed of the impeller amounts to 5500 r.p.m. (with the pre-set constant pressure of $5^{\pm 1}$ kg/sj.cm.). Oil issuing out of the nozzles, flows down into the engine oil sump.

High rotary speed of the oil filter impeller has the effect of dirt contained in oil filling the impeller chamber being whirled away to gether on the impeller cover wall 5.

Following the centrifugation of dirt, oil is passed through the filtering gauze 6, flows next through the hole in the impeller spindle 8 and the filter tube 9, to the main oil duct inside the engine block.

In case of the filtering gauze being clogged, the ball valve 7 is open, for oil to flow down into the tube 9, and hence further to the main oil duct.

2.2. OIL FILTER STRIPPING AND REASSEMBLING

In order to dismantle the oil filter, detach the pipe 6 (Fig. 1) from the filter casing, and unscrew the three bolts securing the filter casing to the cylinder block.

While proceeding to strip the oil filter down, unscrew the bolt 10 securing the cover (Fig 2), then remove successively the oil filter cover 11, the impeller cover 5, the filter gauze 6, the impeller together with the impeller spindle, and unscrew the ball valve 7 out of the impeller spindle.

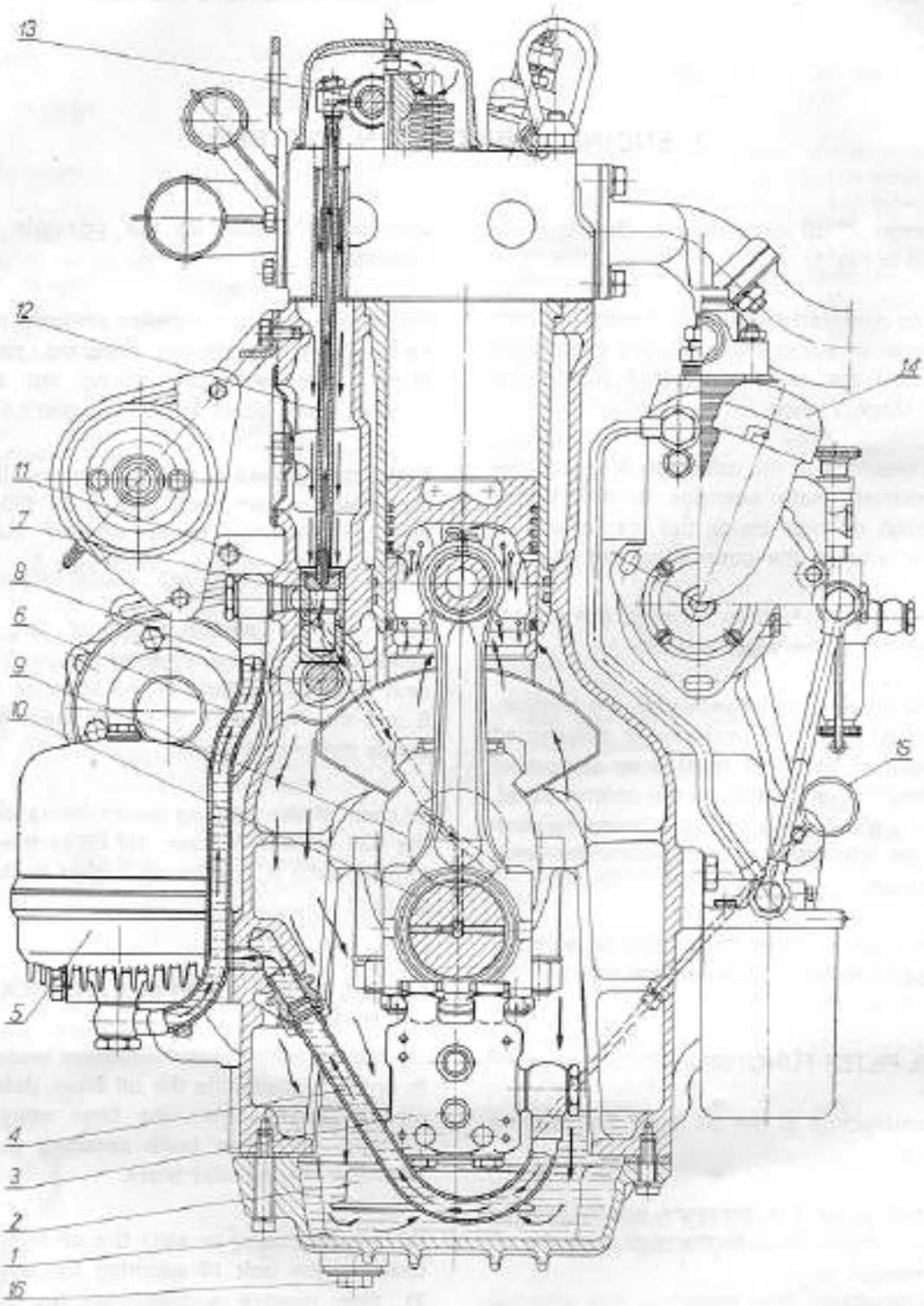

Fig. 1. Engine lubrication system diagram

1 — oil sump, 2 — pump suction strainer, 3 — oil pump, 4 — delivery pipe, 5 — oil filter, 6 — filter pipe, 7 — main oil duct, 8 — camshaft journal, 9 — crankshaft main bearing, 10 — connecting rod big end bearing, 11 — tappet, 12 — tappet rod, 13 — valve rocker bush, 14 — oil filler neck, 15 — oil dipstick, 16 — draining plug

Re-assemble the oil filter by performing the above functions in the reversed sequence of operations.

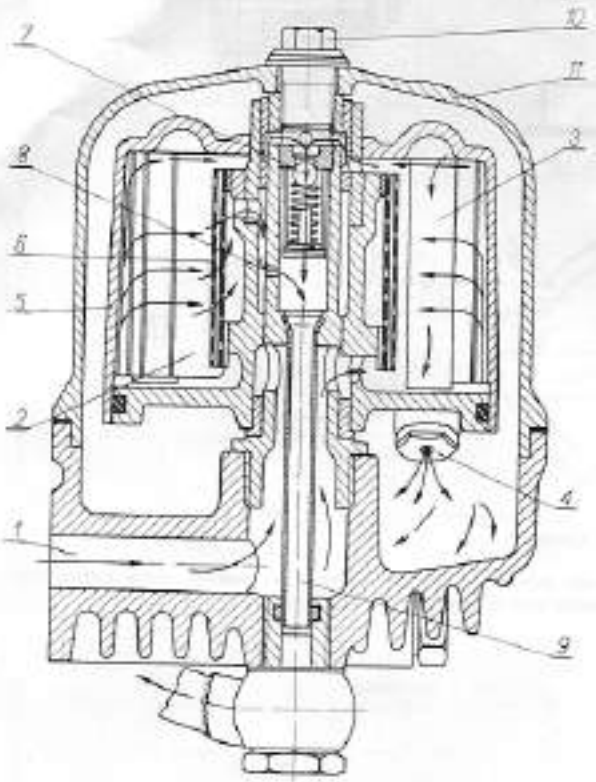

Fig. 2. Centrifugal oil filter

1 — supply channel, 2 — impeller chamber, 3 — tube, 4 — nozzle, 5 — impeller cover, 6 — filter strainer gauze, 7 — ball valve, 8 — hole in impeller spindle, 9 — tube, 10 screw, 11 — filter cover

Unscrew the oil filter valve so, as not to cover up the four holes of 4 mm diameter each drilled in the impeller spindle.

While re-assembling, fit the filter gauze strainer with its broader inner part pointing towards the bottom.

It is to be borne in mind during the re-assembling operation that what with the high rotary speed (approximately 5500 r.p.m.), the impeller base and the impeller cover are mutually dynamically balanced with the accuracy of up to 15 gcm.

In this connection, both parts must originate from the same set, and scratch marks made on the base and on the cover of the impeller must be mutually matching.

Following fitting the impeller complete with cover the filter spindle, check for the impeller to rotate with an adequate ease.

While changing oil in the engine, and following every stripping, clean the oil filter thoroughly up.

Scratch the inner surface of the impeller cover, clean using a wooden spatula for the purpose, or a bakelite one (do not use knife in order not to smooth up the surface), then flush all parts of the filter including the valve, in kerosene.

2.3. OIL PUMP (Fig. 3)

Changes introduced in the oil pump comprise:

— the overflow valve being arranged inside the casing of the oil pump (in the C-350 tractor this valve was accommodated inside the two-stage oil filter),
— change in the arrangement of the suction strainer of the oil pump.

The overflow valve 5 setting adjustment is effected by means of the adjustment tube 6 accommodated inside the overflow valve casing which is capable of being set one of three positions.

The oil pump delivery at 2000 r.p.m. engine speed, with oil temperature ranging 75°—85°C and with oil pressure at the pump outlet, amounts to 36 l/min.

Oil pump replacement and stripping are performed analogically as in the case of the C-350 tractor model.

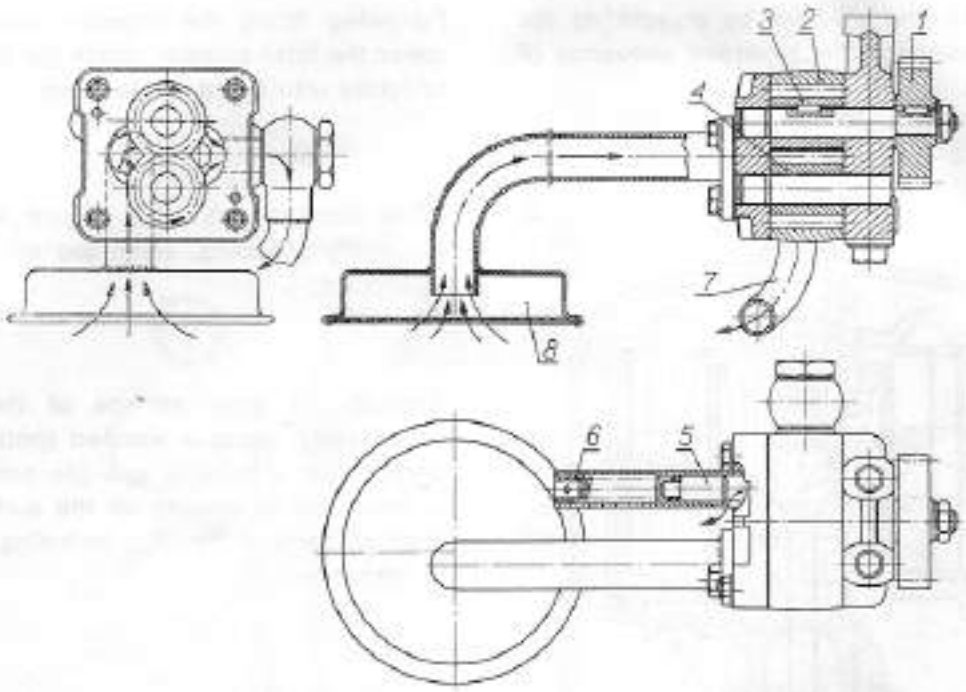

Fig. 3. Oil pump

1 — pump driving gear, 2 — pump casing, 3 — driving gear, 4 — driven gear, 5 — overflow valve, 6 — overflow valve setting tube, 7 — delivery pipe, 8 — pump suction strainer

3. ENGINE COOLING SYSTEM

The radiator fixing within the engine cooling system has been changed, i.e.:

— the radiator bracket has been introduced,
— the radiator has been adapted to fit the new bracket.

The method of fixing the radiator in the C-355 tractor is presented inf Fig. 4.

Furthermore, the upper bulkhead in the radiator tunnel has been abandoned.

The above mentioned changes exert no esential influence on the dismantling and re-assembling functions as described under the S-350 tractor repair instruction.

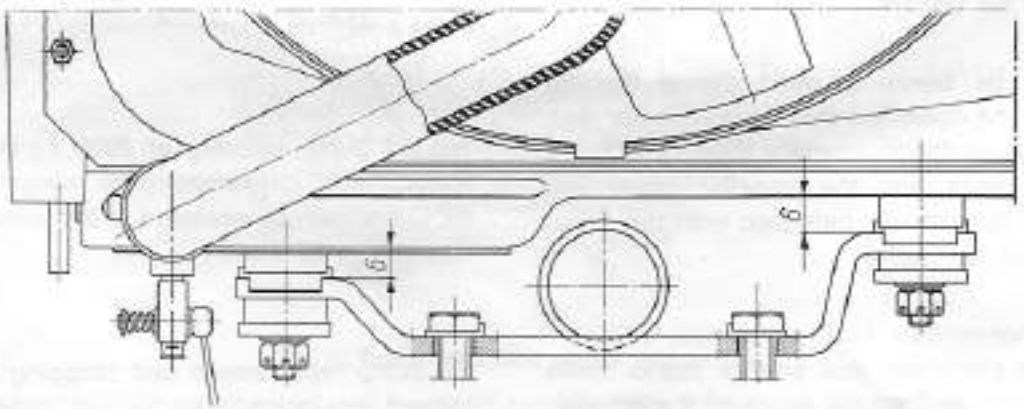

Fig. 4. Radiator to bracket fixing

TEST RECORD CARD

No.	Engine	Injection pump	Speed governor
1	Ursus 4002	P24T8-3a.71BIFVR	R8V20-120/74D

Test rules	Oil grade	Injectors H1.S.3.00/57
	Temperature 35±2.5 °C	Injector nozzles D_1Z_1-12/170
	High pressure pipes 6×2×600	Delivery pressure — 1 atn

Injection pump

Initial stroke 2.4+0.1

Permissible delivery commencement discrepancy ± 0.5

No.	Sense of rotation	delivery sequence	Delivery commencement intervals
1	clockwise	1—3—4—2	every 90°

Injection pump with speed governor

Charge setting	No.	Working speed r.p.m.	Rated fuel charge cu.mm/stroke	Permissible charge discrepancy cu.mm/stroke	Discrepancy between delivery by various elements
	1	900	53	+2 −1	2
	2	250	10—15		4
Boosted charge	1	150	75	±10	20

Speed governor setting r.p.m.	No.	Disengaging commencement range, min.	Disengaging commencement range max.	Disengaging commencement range max.	
	1	max. 220	1010+20	max. 1170	

4. FUEL SUPPLY SYSTEM

The C-355 tractor incorporates the injection pump designated P24T8-3a.71BIFVR with the speed governer R8V20-120/74D. Dismantling, stripping and re-assembling the injection pump are effected in an analogical way as in the C-350 tractor model.

Data covering setting the injection pump are listed in the Test Record Card (sse Page 13).

5. GEARBOX

New additions to the gearbox assembly, comprise:

— re-designed gearbox casing in which the steering gear housing has been abandoned,

— split I and II P.T.O. shaft (Fig. 5),

order to dismantle the P.T.O. shaft II, proceed as follows:

— detach the tractor parts between the engine and the gearbox,

— unscrew the bolts 1 and remove the cover (Fig 6),

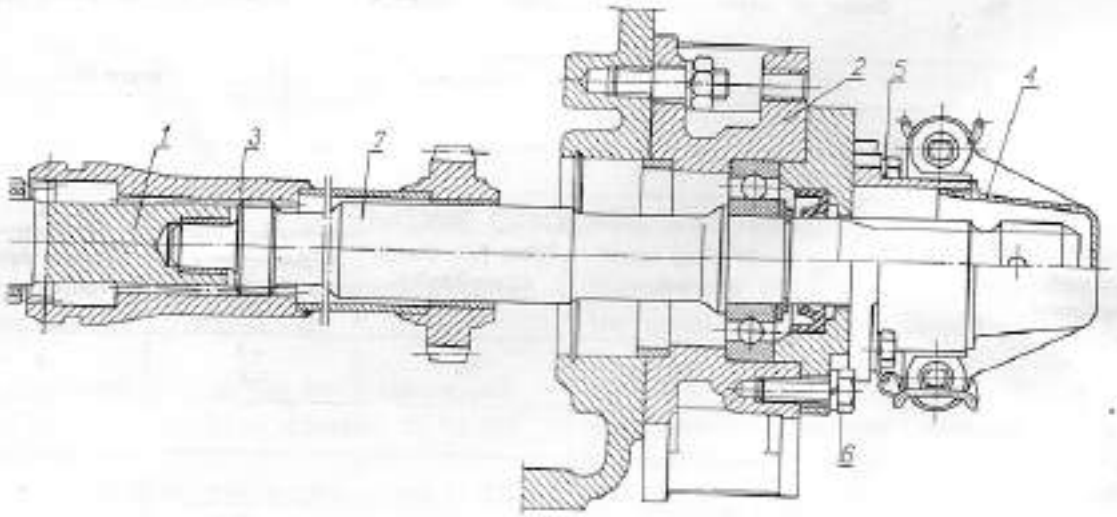

Fig. 5. P.T.O. shaft

1 — P.T.O. shaft I, 2 — intermediate casing, 3 — hydraulic power lift pump drive bush, 4 — shaft guard, 5 — bolt, 6 — bolt, 7 — P.T.O. shaft II

— cover for the front bearing of the P.T.O. shaft (Fig. 7).

The P.T.O. shaft parts I and II are coupled by means of a splined sleeve.

The P.T.O. shaft II (7 in Fig. 5) is removed following unscrewing the bolts 6 in and identical way as in the S-350 tractor model. In

— remove the circlip 3,

— knock off the P.T.O. shaft 4 in the direction as indicated by the arrow mark in the drawing.

Prior to dismantling the P.T.O. shaft I, shift the lever for the engaging of the dependent P.T.O. shaft drive (arranged at the R.H. side on the gearbox cover), into the extreme

rearward position, in order to prevent the pump drive bush 3 (see Fig. 5) dropping. Re-assemble the P.T.O. shafts in reversed sequence of operations in relation to the dismantling.

Note:

While dismantling and re-fitting the P.T.O. shaft I, hold the sliding gear for independent rotation movement, firmly from below. The access to this gear is open following the removal of the bottom cover off the front part of the gearbox.

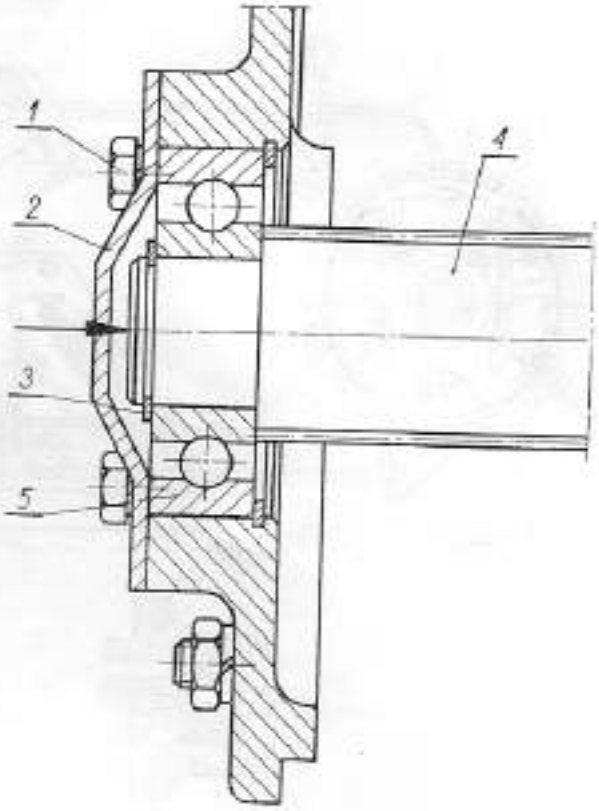

Fig. 6. P.T.O. shaft I front bearing

1 — bolt, 2 — cover, 3 — circlip, 4 — P.T.O. shaft I, 5 — bearing

6. BRAKES

The tractor is equipped with two independent brake systems:

— foot brakes, with hydraulic system control,
— hand brake, with mechanical control system.

Foot brakes (Fig. 7), incorporating brake shoes, acting independently on every rear wheel.

The control of these brakes is effected by means of two brake pumps 1 and two brake pedals 2.

The brake pumps can be actuated by means of brake pedals, either independently or simultaneously. Pumps incorporated in the C-355 tractor model are identical as to their design with those incorporated in the C-350 tractor model.

The brake pedals are coupled by means of the ratchet 3, in order to obtain the effect of brakes acting simultaneously on both rear wheels. Equal pressure inside the slave cylinders 9 of both brakes is then being maintained by the pressure compensator 4.

The design of the pressure compensator is explained in Fig. 8.

The cylinder bore of the pressure compensator amounts to $25.8^{+0.052}$ mm. When proceeding to dismantle the pressure compensator, unscrew the bolts 1, then remove the plungers 2, the spring, and take the compression rings off the plungers.

Re-assembling the pressure compensator is effected in reversed order of operations in relation to the dismantling.

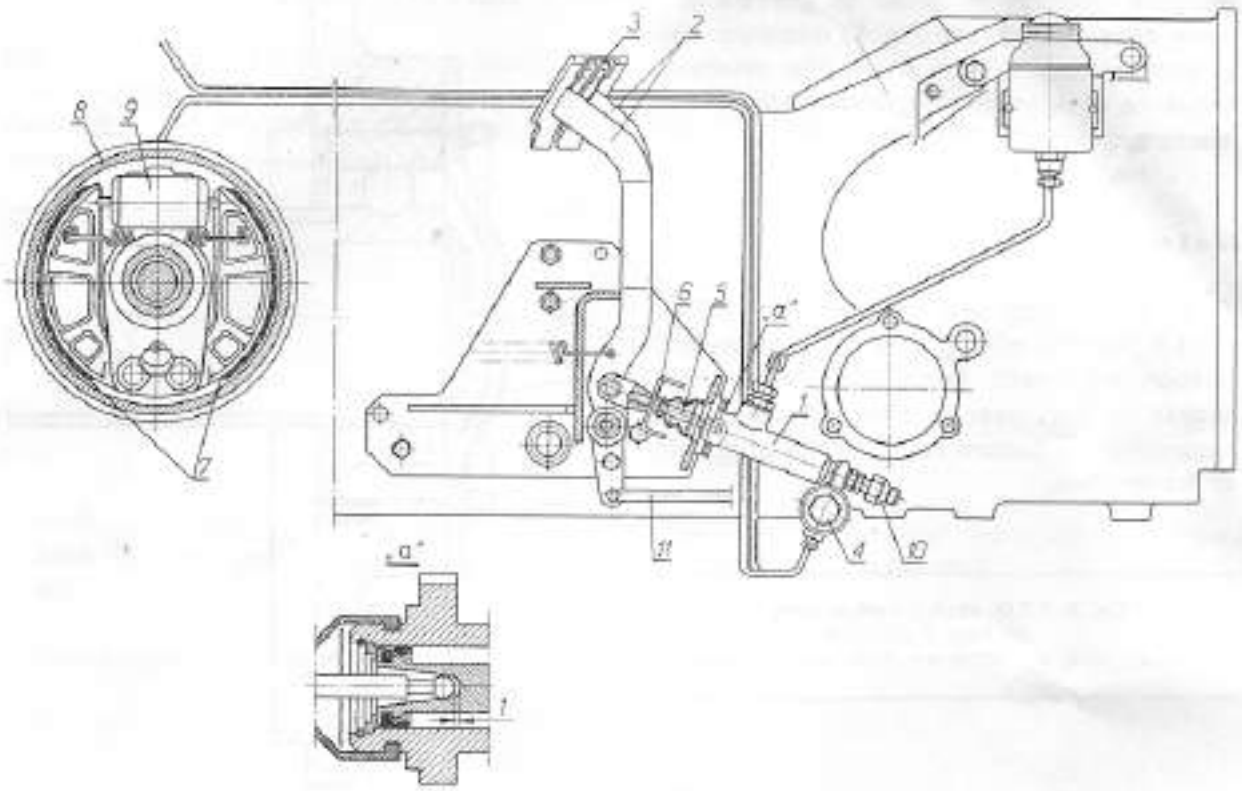

Fig. 7. Foot brakes

1 — brake master cylinder, 2 — pedals, 3 — ratchet, 4 — pressure compensator, 5 — pressure pin, 6 — nut, 7 — brake shoes, 8 — brake drum, 9 — slave cylinder, 10 — hydraulic "stop" light switch, 11 — pullrod

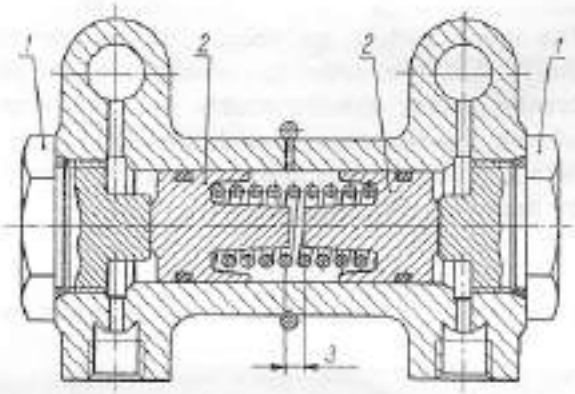

Fig. 8. Pressure compensator

1 — belt, 2 — plunger

One of the brake pumps is linked with the hydraulic "stop" light switch 10. The pullrod 11 links the foot brake pedal with the brake valve of the pneumatic trailer brake control system.

Hand brake (Fig. 9), incorporating a brake band, is controlled by means of the manual lever 1, arranged at the L.H. side of the gearbox. Changes introduced in the C-355 tractor model in this respect cover an alteration in the design of the hand brake lever and of its fixing.

6.1. BRAKE SETTING

Setting the foot brakes involves selecting the clearance between the brake pump plunger, and the hold-down pin 5 (Fig. 7, detail "a").

This clearance should amount to no more than 1 mm, and it is being set by means of the nut 6.

With the hold-down pin clearance set properly, free travel of the brake pedal, as measured at the ends of the plate, should amount to 40—70 mm. The clearance between the brake shoes 7, and the brake drum 8, is controlled automatically by means of the cylinder 9.

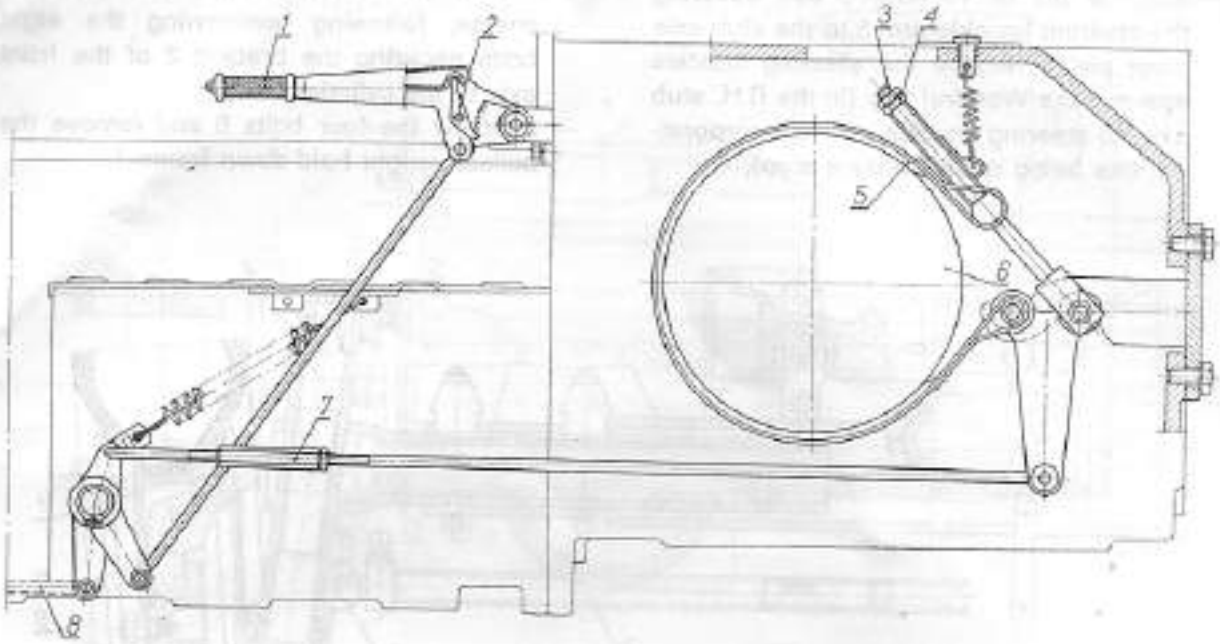

Fig. 9. Hand brake
1 — brake lever, 2 — ratchet, 3 — locknut, 4 — nut, 5 — brake band, 6 — brake drum, 7 — nut, for setting; 8 — pull rod

The rules covering the hand brake setting and adjustment undergo no changes. Setting this brake is being effected in compliance with the recommendations listed in the C-350 tractor servicing instruction.

7. FRONT AXLE

The C-355 tractor is equipped with the front axle of a tubular section (Fig. 10) swivel mounted on the swivel pin 12 which is secured to the bracket 11.

The retractable half-shafts 6 permit four various wheel tracks being obtained, i.e. 1350 and 1750 mm respectively. Standard front wheel track amounts to 1350 mm.

The change in the front wheel track is being obtained by changing the position of the retractable half-shaft 6 in relation to the front axle beam 8.

The position of the retractable half-shaft is secured by means of clamping yokes. The front wheel track change involves simultaneously an alteration in the length of the tie rod 7, and an adjustment of the front wheel toe-in.

The method of dismantling and re-assembling the front axle and elements thereof has undergone basically no changes. An exemption herefrom present the stub axles and the pivot pin of the front axle. What with the changes having been introduced in the steering system, the front wheel toe-in alignment has also been changed.

7.1. STUB AXLE DISMANTLING

Dismantling the stub axle is being effected in the following way (Fig. 10):

— unscrew the four bolts securing the stub axle 4 pivot pin to the stub axle pivot pin 4, and remove the steering knuckle arm 3 and the stub axle pivot pin (together with the wheel),

— unscrew the M14×1.5×75 bolt securing the steering knuckle arm 5 to the stub axle pivot pin 4, remove the steering knuckle arm and the Woodruf key (in the R.H. stub axle no steering knuckle arm is incorporated, this being replaced by a stop),

— detach the whole front axle from the engine, following unscrewing the eight bolts securing the bracket 2 of the front axle to the cylinder block,

— unscrew the four bolts 6 and remove the ballast weight hold-down frame 1,

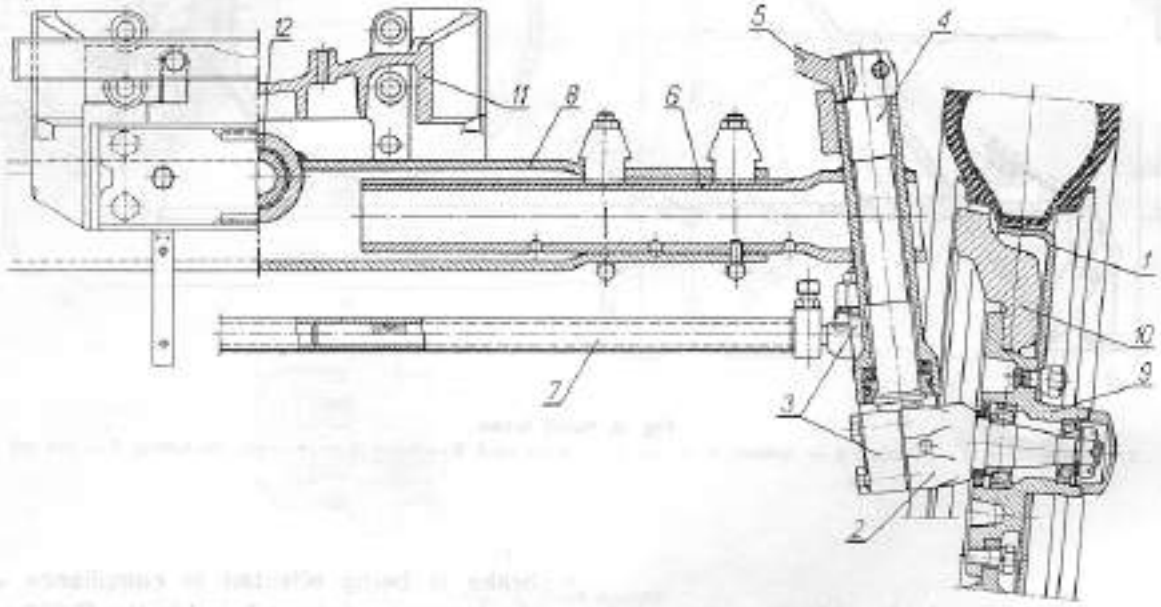

Fig. 10. Front axle

1 — front wheel disc, 2 — swivel pin, 3 — steering knuckle, 4 — stub axle pivot pin, 5 — steering knuckle arm, 6 — retractable half-shaft, 7 — tie rod, 8 — front axle, 9 — wheel hub, 10 — ballast weights, 11 — front axle bracket, 12 — pivot pin

— push the stub axle pivot pin out, downwards,

— remove the thrust bearing and the sealing ring off the stub axle pivot pin,

— remove the bushes out of the stub axle housing.

While re-assembling proceed in reversed sequence of operations in relation to the dismantling.

Rated dimensions:

— bushes — $40^{-0.025}_{-0.050}$ mm

— stub axle pivot pin — $40^{+0.025}$ mm

7.2. DISMANTLING THE FRONT AXLE OFF THE BRACKET

In order to dismantle the front axle off the bracket, proceed as follows (Fig. 11):

— unscrew the four bolts 3 and remove the pivot pin cover 7,

— knock the pivot pin 4 off the bracket, towards the direction as indicated in the drawing by the arrow mark, and remove the front axle beam,

— remove the bushes of the pivot pin 5, if necessary.

Proceed in reversed sequence of operations in relation to the dismantling, while re-fitting the front axle on the bracket.

Rated dimensions:

— bushes — $55^{-0.035}_{-0.076}$ mm

— front axle pivot pin — $55^{+0.046}$ mm

7.3. FRONT WHEELS TOE-IN ALIGNMENT

The front wheels toe-in alignment is effected in the C-355 tractor model by changing the length of the tie rod (7 in Fig. 10).

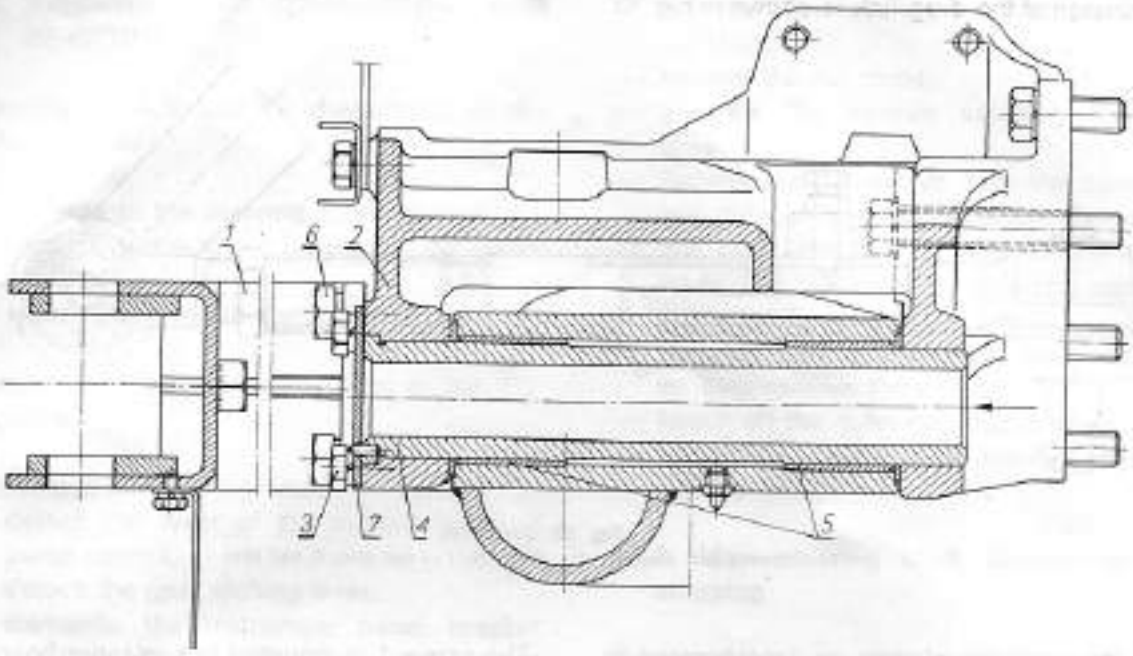

Fig. 11. Lengthwise front axle bracket section

1 — ballast weights hold-down frame, 2 — front axle bracket, 3 — bolts, 4 — pivot pin, 5 — bushes, 6 — ballast weights frame bolt, 7 — swivel pin cover

The change in the length of the tie rod is obtained by operating the tie rod as required, following the slackening of the clamping screw at one end, and the setting nut at the other end. The toe-in of the front wheels should amount to 4—10 mm. Following setting the toe-in as required, re-tighten the clamping screw, and the setting nut.

8. STEERING SYSTEM

The steering system of the C-355 tractor is presented in the form of a diagram in Fig. 12

The movement of the steering wheel 1 is transmitted onto the L.H. side wheel stub axle through the steering gear 2, the steering gear drop arm 3, the drag link 4, the stub axle link 5. The swivel pin of the L.H. side wheel stub axle is linked with that of the R. H. sidewheel stub axle by means of the steering gear drop arm 6 and of the tie rod 7. The steering rods are terminated by ball joints, and their lengths is adjustable. The joints I and IV are provided with threaded end-pieces, and are mutually interchangeable.

The joints II and III, on the other hand, are provided with retractable end-pieces and are not mutually exchangeable.

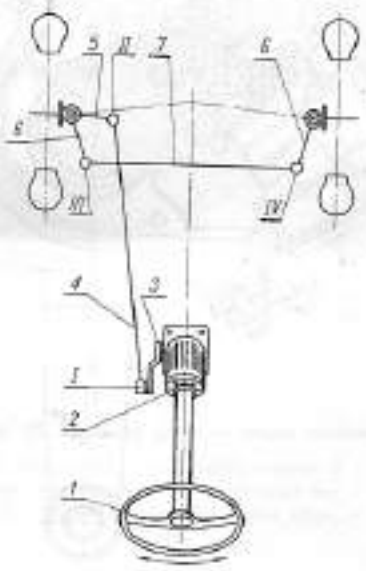

Fig. 12. Steering system diagram

1 — steering wheel, 2 — steering gear, helical-and-spherical type, 3 — steering gear drop arm, 4 — drag link, 5 — steering knuckle arm, 6 — stub axle link, 7 — tie rod, I, II, III, IV — ball joints

The design of the drag link is shown in Fig. 13.

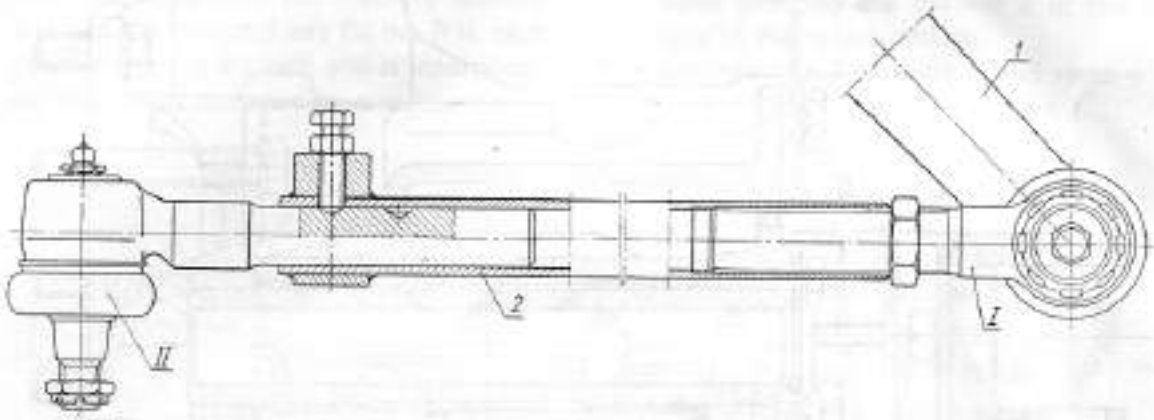

Fig. 13. Drag link
1 — steering gear drop arm, 2 — drag link, I — ball joint, II ball joint

The transmission system as incorporated in the steering-gear (Fig. 14) is of helical-and-globoidal type. The steering shaft is terminated by the screw provided with a convex-and-radial thread profile.

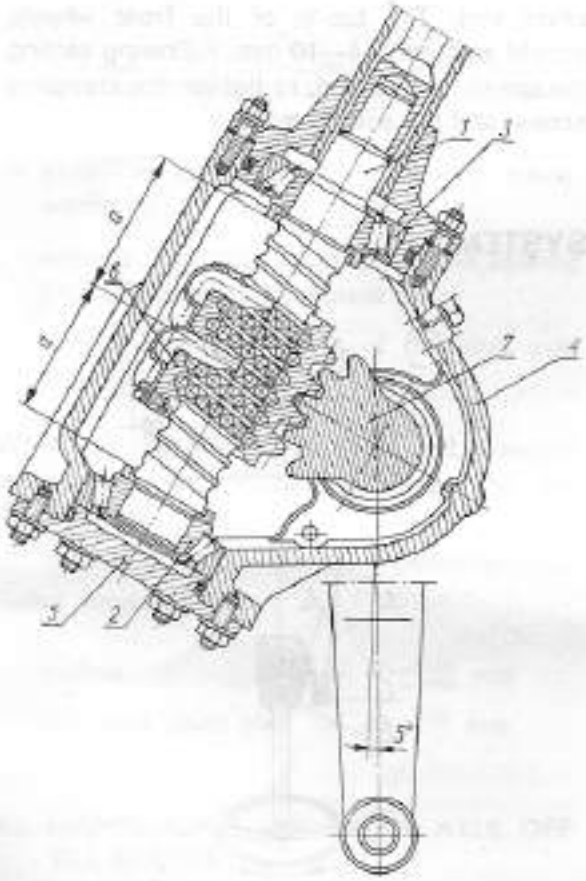

Fig. 14. Steering gear — lengthwise section
1 — steering shaft, 2 — taper roller bearing, lower, 3 — taper roller bearing, upper, 4 — steering gear housing, 5 — bottom cover, 6 — nut, 7 — steering main shaft

The screw 1 is mounted in two taper bearings 2 and 3. The outer ring of the upper bearing is force-fitted into the upper cover, and that of the lower bearing — in the housing of the steering gear 4. The lower bearing is protected against sliding off, by means of the lower cover 5. The screw is fitted with the nut 6 which is also provided balls are rolling between the thread of the screw and that of the nut. The outer surface of the nut is provided with a machined rack which is intermeshed with the sector of the gear of the main shaft 7. While rotating the steering wheel (the screw), the movement of the nut in the lengthwise direction causes the main shaft to turn, and this movement is being then transmitted through the steering gear drop arm, onto the drag link. The steering gear is accommodated inside the housing bolted to the casing of the gearbox.

Specification data.

Steering wheel play	— maximum 20°
Steering wheel turning angle (over the entire range of steering wheel turn)	— 4.25×360°
Steering system transmission ratio	— 17.0:1
Steering gear transmission ratio	— 23.5:1
Ball diameter	— 5/16" II-P-4 according to PN-84/M-86452 Polish Standard form
Number of steel balls	— 110 each
Oil quantity	— 1.05 l

8.1. STEERING GEAR DISMANTLING AND RE-FITTING

Steering gear is due for dismantling in the following cases:

— damage to the steering gear housing,
— damage to the lower bearing of the steering shaft,
— replacement of the complete assembly.

Sequence of operations involved in the dismantling:

— remove the steering wheel,
— detach the lever of the manual injection pump control,
— detach the gear shifting lever,
— dismantle the instrument panel bracket together with the instrument panel (do not detach electric cables),
— unscrew the gear shifting lever ball bearing,
— pull the steering rod off,
— drain oil off the steering gear (this can also be effected following dismantling the steering gear off the tractor),
— detach the steering gear housing off the gearbox casing.

Re-fitting the steering gear is effected in reversed sequence of operations in relation to the dismantling.

8.2. STEERING GEAR STRIPPING

The steering gear may be stripped down following its dimantling off the tractor according to para 8.1., as well as directly while mounted on the tractor.

8.2.1. Dismantling and stripping the steering shaft including the nut

Sequence of operations involved in the dismantling and stripping (Fig. 14):

— unscrew the six nuts securing the upper gear cover,
— operate the steering wheel (while mounted temporarily over the wedge and shaft) clockwise, pull the steering column out together with the shaft and nut,
— pull the inner bearing rings off the steering shaft,
— remove the nut stops,
— unscrew the screws securing the ball guideways,
— remove the guideways, take the balls out, and detach the steering wheel nut,
— pull the outer bearing ring off the upper cover (of the steering column), using a puller for this purpose,
— unscrew the nuts securing the lever cover, then remove the cover,
— knock off the outer ring of the lower bearing off the steering gear housing, using a drift for this purpose.

8.2.2. Main steering shaft dismantling and stripping

Sequence of operations involved in the dismatling and stripping (Fig. 15):

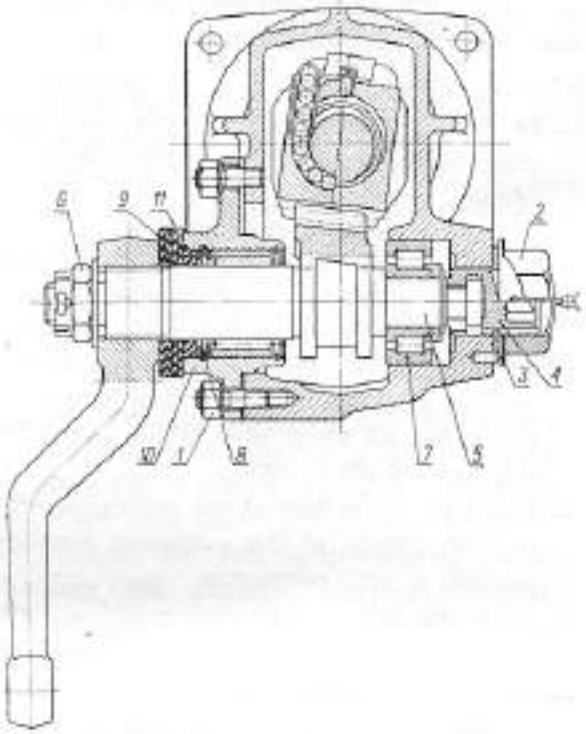

Fig. 15. Steering gear — cross section

1 — nut, 2 — setting nut, 3 — locating washer, 4 — set screw plug, 5 — main steering shaft, 6 — castellated nut, 7 — bearing, 8 — circlip, 9 — rubber washers, 10 — side cover, 11 — sealing ring

— unscrew the six nuts 1 securing the side cover,

— release and unscrew the set screw plug 2, remove the locating washer 3,
— turn set screw plug 4 clockwise using a socket wrench, until tightened firmly, and holding the steering gear drop arm upright while doing so,
— pull the main steering shaft 5 out, remove the set screw plug 4,
— release and unscrew the nut 6,
— remove the steering gear drop arm off the steering shaft, remove the rubber washers 9, the side cover 10, the bearing securing ring, and the bearing 7,
— remove the sealing ring 11 off the side cover, then the circlip 8 and the needle roller bearing.

8.3. STEERING GEAR REFITTING

8.3.1. Refitting the steering gear together with the nuts and taper roller bearing clearance setting

Sequence of operations involved (Fig. 14):
— fit the upper stop of the nut over the steering shaft, then force fit the inner ring of the upper bearing,
— fit the nut over the steering shaft,
— insert one half of the guideway into the nut, for the depth of approximately 10 mm and position the steering shaft together with the nut so, as for the channel in the guideway to run in the horizontal plane,
— insert the 55 steel balls while operating the steering shaft slightly,
— insert the other half of the guideway, and fit both halves of the guideway simultaneously in, until resistance,
— re-fit the other guideway together with balls in and analogical way,
— screw the guideway firmly inside the nut,
— fit the lower stop of the nut onto the steering shaft, and force fit the inner ring of the lower bearing,
— fit the outer bearing rings into the steering gear upper cover and housing, respectively,
— bolt the lower steering gear cover together with the sealing ring on,
— insert the nut together with the steering shaft, into the housing,
— re-fit and screw on slightly the steering column to the housing, (with no shims fitted),
— measure the play between the steering gear casing and the upper cover,
— select the thickness of shims to be inserted according to the play as measured,
— slacken the nuts of the upper cover and insert the shims,
— tighten the nuts of the upper cover and check the steering shaft bearing clearance.

Note:

The bearing clearance should be selected in such a way, as for the steering shaft to betray no perceptible axial play, and to rotate freely under the force of P = 0.2 — 0.5 kg when applied on the steering wheel periphery.
— On completion of the bearing clearance check, remove the steering shaft together with the nut, prior to fitting the main shaft.

8.3.2. Main shaft refitting and steering gear play setting

Sequence of operations involved (Fig. 15):

— fit the bearing 7 and the bearing locating ring, over the steering gear main shaft,
— insert the needle roller bearing (39 each of needles), the circlip 8 and the sealing ring 11, inside the side cover 10,
— fit the side cover 10, the rubber washers 9, over the steering gear main shaft,
— fit over the steering gear main shaft 5, the steering gear drop arm in such a way, as for the marks imprinted on the shaft and on the drop arm hub, to match mutually (Fig. 16),
— screw the nut 6 on, and protect the nut by means of a split pin,
— fit over the main shaft 5, the set screw plug 4, and insert the main shaft into the steering gear housing,
— use socket wrench to tighten the set screw plug 4 primarily (by turning anti-clokwise) so, as to enable fitting the shaft together with the nut in,
— screw on the 6 nuts of the side cover,
— insert the steering shaft together with the nut inside the housing, in such a way as for the central tooth of the geared sector

of the main shaft to intermesh with the central recess in the nut toothing (see dimension "a" in Fig. 14).

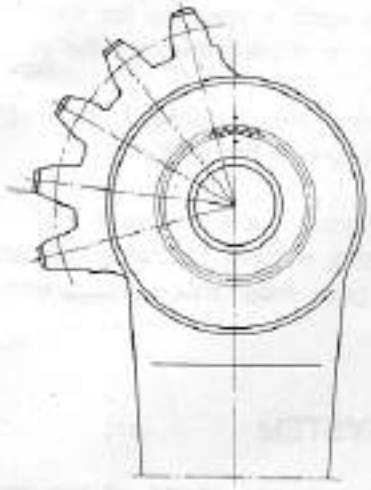

Fig. 16. Steering gear drop arm hub positioning in relation to the main shaft

— fit the steering column over the steering shaft, and secure it by means of six nuts to the steering gear housing, following fitting the adjustment shims as selected previously,

— operate the set screw plug 4 to set the steering play: this play, as measured over the steering wheel periphery, should amount to 10°—15°,

— fit the locating washer 3,

— tighten and secure the setting nut 2.

8.4. STEERING SYSTEM SETTING

1. Check the front wheel alignment and adjust if necessary.

2. Check the functioning of front wheel turning stops.

With the wheels turned to extreme right or left, at least one of the turning stops for the direction in question should rest against one of the two buffers arranged on the retractable half-shafts. Should this conditions not be met, proceed with the adjustment of the steering system by changing the length of the drag link.

Changing the drag link length is effected in the following way:

— slacken the drag link locknut at the side of the rear end-piece,
— slacken the drag link locknut at the side of the front end-piece,
— unscrew the clamping bolt,
— operate the drag link (a single turn has the effect of changing the drag link length by 2 mm),
— with the required drag link length having been obtained, replace the clamping bolt and re-tighten the locknuts.

Check the correct adjustment of the steering system in the following way:

— raise the tractor front by means of the lifting jack,
— move the steering wheel clockwise, until the stop comes to rest against the buffer,
— mark the position of the face of the drag link on the front end-piece of the drag link,
— slacken the locknut of the clamping bolt,
— unscrew the clamping bolt,
— move the steering wheel clockwise until resistance,
— measure the distance of the drag link face from the position as marked previously, with the stop rested against the buffer,
— turn the front wheels clockwise (to the right), without to move the steering wheel, so as for the turning stop to come to rest against the buffer,
— turn the steering wheel anti-clockwise (to the left) until resistance, by guiding the drag link in parallel to the front end-piece of the drag link,
— measure the distance of the drag link face from the position marked previously, whereas the turning stop must be rested against the buffer,
— detract 12 mm from the sum of distances thus measured, and drivide the result by two; the result thus obtained is the setting measure,
— turn the steering wheel clockwise (to the right) until resistance,
— turn the front wheels clockwise (to the right), so as for the turning stop to come to rest against the buffer, while fitting simultaneously the drag link pipe over the front end-piece,

— operate the drag link in such a way, as for distance from the drag link face to the position marked previously to be equal with the dimension as calculated for the setting (with the accuracy of up to 2 mm),
— link the drag link with the end-piece.

Note:

Should the drag link prove too long following screwing the drag link pipe over the drag link end-piece, proceed as follows:

— release and slacken the castellated nut securing the steering gear drop arm,
— take the drop arm off the splined end of the steering gear shaft with the initial position of the marks on the drop arm shaft and hub borne in mind,
— shift the drop arm one tooth on the splined end in such a way, as for the drop arm end to be moved towards the rear of the tractor,
— re-tighten the castellated nut and secure it by means of the split pin.

Rules covering the adjustment and check of the steering system following adjusting the steering gear drop arm, remain unchanged.

9. IMPLEMENT LINKAGE SYSTEM

The shape of the implement hitch incorporated into the C-355 tractor implement linkage system has been altered. Thanks to this change, there is no longer the necessity occuring for dismantling the hitch while fitting the belt pulley attachment.

The change in the shape of the implement hitch does not affect the dismantling-and-re-assembling functions as described in the C-350 tractor servicing instruction.